Radiological Health Data

VOLUME III, NUMBER 3

MARCH 1962

MONTHLY REPORT

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis and interpretation of data on environmental radiation levels. The Department delegated this responsibility to the Division of Radiological Health, Public Health Service.

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RADIOLOGICAL HEALTH DATA

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SECTION I.—AIR

Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, it consisted of 45 stations at urban locations operated by State and local health department personnel, except for 2 stations which were operated by Public Health Service personnel. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the network was expanded over a period of a few months to 64 stations (see figure 1).

Measurements of gross beta radioactivity in air at ground level are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone.

Daily air samples are collected continuously by a high volume air sampler with a carbon-loaded cellulose dust filter. In addition to the particulates retained on the filter, some gaseous fission products are adsorbed by the carbon. Field measurements with a portable survey meter enable the operator to estimate the amount of beta activity of particulates in air at the station five hours after collection by comparison with a known radioactive source. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network in Washington, D. C., for a more refined measurement using a thin-window proportional counter. Table 1 presents the monthly summary report of fission product gross beta concentrations in surface air during December 1961.

Continuous precipitation samples are taken at each station over daily sampling periods, using locally-made funnels having collection areas of 0.4 square meter. One-half liter of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples.

The results in tables 2 and 3 are the monthly summations of the daily precipitation (mm) and the associated gross beta activity ($\mu\mu c/m^2$) for October and November 1961. Overall average gross beta concentrations in $\mu\mu c$/liter for each month's total precipitation may be calculated directly from the data, which yield the dimensionally desired results when activities are divided by the appropriate precipitation totals, i.e.,

$$\text{Average concentration } (\mu\mu c/\text{liter}) = \frac{\text{Activity } (\mu\mu c/m^2)}{\text{Total precipitation (mm)}}$$

When the activity of a given daily sample was too low for reliable measurement, an activity representing the minimum level of detection was included in the monthly summation. In the event that the sum of such values is greater than one-tenth of the total gross beta activity for the month, the monthly activity is reported with a "less than" ($<$) sign.

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS

TABLE 1.—RADIOACTIVITY OF PARTICULATES IN AIR, GROSS BETA DETERMINATIONS, DECEMBER 1961

[Concentrations in $\mu\mu c/m^3$]

Station location		Number samples	Maximum	Minimum	Average[1]	Station location		Number samples	Maximum	Minimum	Average[1]
City	State					City	State				
Adak	Alaska	27	8.6	<0.10	5.0	Minneapolis	Minn.	29	9.2	2.0	4.7
Anchorage	Alaska	31	11	0.19	6.0	Jackson	Miss.	25	16	1.0	6.1
Attu	Alaska	26	12	0.15	3.7	Pascagoula	Miss.	16	17	3.4	9.8
Cold Bay	Alaska	31	10	0.62	4.3	Jefferson City	Mo.	28	15	1.1	5.1
Fairbanks	Alaska	16	9.8	1.3	5.4	Helena	Mont.	31	14	2.9	7.1
Juneau	Alaska	26	18	<0.10	4.7	Lincoln	Nebr.	4	5.5	2.0	4.1
Kodiak	Alaska	28	18	0.10	5.8	Trenton	New Jersey	25	11	0.58	4.2
Nome	Alaska	27	11	0.19	5.4	Santa Fe	N. Mex.	28	27	2.5	12
Point Barrow	Alaska	31	7.0	1.7	4.0	Albany	N. Y.	27	15	0.96	5.0
St. Paul Island	Alaska	10	5.5	0.19	2.7	New York	N. Y.	15	20	2.5	8.4
Phoenix	Ariz.	28	32	3.6	14.0	Gastonia	N. C.	28	21	0.32	6.5
Little Rock	Ark.	28	11	0.64	5.3	Bismarck	N. Dak.	28	7.6	2.3	4.8
Berkeley	Calif.	28	26	1.6	9.6	Columbus	Ohio	27	20	1.9	7.8
Los Angeles	Calif.	25	40	4.7	15	Oklahoma City	Okla.	27	15	1.6	7.4
Denver	Colo.	26	32	4.1	15	Ponca City	Okla.	26	16	1.4	4.3
Hartford	Conn.	28	11	1.3	4.9	Portland	Oreg.	27	10	0.39	5.6
Washington	D. C.	31	13	0.18	6.5	Harrisburg	Pa.	27	12	0.65	5.3
Jacksonville	Fla.	28	22	2.1	13	San Juan	P. R.	20	13	0.94	3.7
Miami	Fla.	28	19	2.3	9.9	Providence	R. I.	28	13	1.7	5.9
Atlanta	Ga.	31	19	0.66	7.3	Columbia	S. C.	26	13	1.3	6.8
Agana	Guam	26	5.2	0.60	2.5	Pierre	S. D.	31	12	2.7	5.9
Honolulu	Hawaii	27	7.2	1.2	2.9	Nashville	Tenn.	29	18	0.47	7.3
Boise	Idaho	27	15	3.2	9.2	Austin	Tex.	27	12	0.32	6.6
Springfield	Ill.	31	10	2.2	5.7	El Paso	Tex.	27	19	1.0	10
Indianapolis	Ind.	28	14	1.4	5.7	Salt Lake City	Utah	28	15	2.3	9.1
Iowa City	Iowa	30	9.7	1.9	4.5	Richmond	Va.	29	24	0.35	5.7
Topeka	Kans.	28	6.2	2.1	4.1	Seattle	Wash.	28	5.2	0.19	2.4
Frankfort	Ky.	28	18	1.5	7.0	Madison	Wis.	28	15	2.1	5.5
New Orleans	La.	28	15	1.2	7.4	Cheyenne	Wyo.	28	33	1.1	10
Augusta	Maine	17	8.8	1.2	5.0	Sundance	Wyo.	3	7.8	3.0	5.5
Baltimore	Md.	31	12	0.19	5.3						
Lawrence	Mass.	28	11	1.1	4.4	Network average					6.5
Lansing	Mich.	29	15	2.3	7.7						

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

TABLE 2.—GROSS BETA RADIOACTIVITY IN PRECIPITATION, OCTOBER 1961

Station location		Total precipitation (millimeters)	Activity ($\mu\mu c/m^2$)	Station location		Total precipitation (millimeters)	Activity ($\mu\mu c/m^2$)
City	State			City	State		
Anchorage	Alaska	53.1	153,000	Jefferson City	Missouri	69.1	143,000
Fairbanks	Alaska	27.3	92,400	Helena	Montana	1.00	8,600
Juneau	Alaska	403.0	1,110,000	Santa Fe	New Mexico	25.1	6,900
Kodiak	Alaska	[a]—	—	Albany	New York	33.2	73,700
Little Rock	Arkansas	3.22	6,100	Oklahoma City	Oklahoma	54.1	<26,400
Berkeley	California	2.04	—	Ponca City	Oklahoma	74.1	159,000
Denver	Colorado	5.17	54,700	Portland	Oregon	70.6	545,000
Hartford	Connecticut	50.0	43,100	Harrisburg	Pennsylvania	17.5	24,500
Washington	D. C.	61.6	208,000	San Juan	Puerto Rico	9.37	<3,300
Jacksonville	Florida	28.4	<9,100	Providence	Rhode Island	77.2	118,000
Honolulu	Hawaii	50.7	<22,400	Columbia	South Carolina	15.5	18,300
Boise	Idaho	58.3	307,000	Pierre	South Dakota	17.1	61,000
Springfield	Illinois	71.2	237,000	Nashville	Tennessee	6.75	—
Indianapolis	Indiana	25.1	53,200	Austin	Texas	20.4	<11,700
Iowa City	Iowa	73.4	75,100	El Paso	Texas	1.53	5,800
Topeka	Kansas	115.6	<69,800	Salt Lake City	Utah	53.3	327,000
New Orleans	Louisiana	127.1	236,000	Richmond	Virginia	97.6	125,000
Lawrence	Massachusetts	57.2	128,000	Seattle	Washington	54.2	274,000
Lansing	Michigan	55.0	111,000	Madison	Wisconsin	88.4	114,000
Minneapolis	Minnesota	92.0	173,000	Cheyenne	Wyoming	10.1	49,000
Pascagoula	Mississippi	103.0	<36,200				

[a] Dash denotes no sample received.

TABLE 3.—GROSS BETA RADIOACTIVITY IN PRECIPITATION, NOVEMBER 1961

Station location		Total precipitation (millimeters)	Activity ($\mu\mu c/m^2$)	Station location		Total precipitation (millimeters)	Activity ($\mu\mu c/m^2$)
City	State			City	State		
Adak	Alaska	—[a]	—	Minneapolis	Minnesota	29.8	141,000
Anchorage	Alaska	10.2	—	Jackson	Mississippi	76.3	—
Attu	Alaska	—	—	Pascagoula	Mississippi	—	—
Cold Bay	Alaska	—	—	Jefferson City	Missouri	53.8	93,300
Fairbanks	Alaska	8.62	97,700	Helena	Montana	17.9	167,000
Juneau	Alaska	219.0	988,000	Lincoln	Nebraska	5.62	—
Kodiak	Alaska	—	—	Trenton	New Jersey	—	—
Nome	Alaska	—	—	Santa Fe	New Mexico	22.7	60,000
Point Barrow	Alaska	—	—	Albany	New York	73.0	133,000
St. Paul Island	Alaska	—	—	New York	New York	—	—
Phoenix	Arizona	—	—	Gastonia	North Carolina	60.5	77,800
Little Rock	Arkansas	243.1	168,000	Bismarck	North Dakota	—	—
Berkeley	California	102.3	226,000	Columbus	Ohio	37.7	29,000
Los Angeles	California	67.6	238,000	Oklahoma City	Oklahoma	24.7	8,600
Denver	Colorado	18.6	39,000	Ponca City	Oklahoma	89.1	206,000
Hartford	Connecticut	73.2	212,000	Portland	Oregon	83.3	336,000
Washington	D. C.	46.9	109,000	Harrisburg	Pennsylvania	27.3	56,200
Jacksonville	Florida	27.8	35,600	San Juan	Puerto Rico	16.9	13,600
Atlanta	Georgia	51.4	80,300	Providence	Rhode Island	74.0	309,000
Honolulu	Hawaii	98.0	<88,800	Columbia	South Carolina	26.8	79,000
Boise	Idaho	24.6	224,000	Pierre	South Dakota	—	—
Springfield	Illinois	33.9	—	Nashville	Tennessee	104.3	2,400
Indianapolis	Indiana	77.6	134,000	Austin	Texas	57.2	87,700
Iowa City	Iowa	143.7	224,000	El Paso	Texas	33.8	134,000
Topeka	Kansas	58.5	215,000	Salt Lake City	Utah	23.5	70,800
Frankfort	Kentucky	—	—	Richmond	Virginia	48.4	97,000
New Orleans	Louisiana	179.1	<149,000	Seattle	Washington	79.6	238,000
Baltimore	Maryland	—	—	Madison	Wisconsin	121.8	205,000
Lawrence	Massachusetts	63.5	268,000	Cheyenne	Wyoming	4.6	64,400
Lansing	Michigan	50.5	169,000	Sundance	Wyoming	—	—
				Agana	Guam	—	—

[a] Dash denotes no sample received.

Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

Robert A. Taft Sanitary Engineering Center, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon–222) and thoron (radon–220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon (Rn^{222}) and its daughters. Thoron (Rn^{220}) and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program for radon (Rn^{222}), thoron (Rn^{220}), and gross beta fission product concentrations in surface air at Cincinnati, Ohio. The gross beta activity of atmospheric particulates, when measured several days after sample collection, is principally due to artificially produced radionuclides.

Radon–222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon–222 (a.m.) concentrations have been corrected for any radon–220 daughter interferences. Radon–222 (p.m.) concentrations are derived from alpha measurements made in

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, NOVEMBER 6–DECEMBER 1, 1961

End of sampling period	Continuous sample collection			Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m.[a] ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
	Sample change time	Sample period (hours)	Volume (m^3)				
November 6	0800	71.7	88.4	240	100	1.7	5.58
7	0800	24.0	29.4	480	140	3.3	1.58
8	0810	24.1	29.3	260	100	2.5	3.90
9	0801	23.8	28.8	340	130	2.7	5.30
13	0815	96.2	112.5	730	240	5.8	10.26
14	0810	23.9	28.8	250	370	1.6	10.50
15	0820	24.1	28.9	370	300	1.7	2.26
16	0800	23.6	27.9	120	140	1.4	3.10
17	0800	23.9	28.1	110	70	0.4	10.08
20	0800	71.9	84.3	160	60	1.6	1.28
21	0810	24.1	28.8	550	100	2.2	3.24
22	0800	23.8	28.1	300	280	2.2	3.91
24	0800	47.9	68.1	220	190	0.9	8.32
27	0800	71.9	83.0	280	140	2.3	6.35
28	0805	24.0	27.9	330	80	1.4	6.89
29	0805	23.9	27.6	610	100	3.9	3.15
30	0810	24.0	27.6	570	120	3.6	2.93
December 1	0800	23.8	27.6	510	200	4.4	4.34
Average				360	160	2.6	5.7
Range of counting errors (2σ)							
Maximum				48	30	0.8	0.2
Minimum				23	14	0.3	0.1

[a] Sample period and volume does not apply to this column.

TABLE 2.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, DECEMBER 4–29, 1961

End of sampling period	Continuous sample collection			Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m.[a] ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
	Sample change time	Sample period (hours)	Volume (m^3)				
December 4	0807	72.0	82.2	330	100	5.2	13.98
5	0800	23.8	27.5	220	100	1.4	7.68
6	0807	24.0	27.9	320	110	2.7	6.25
7	0800	23.8	27.8	180	120	1.5	4.70
8	0808	24.1	28.4	190	130	1.4	4.19
11	0803	71.8	83.3	220	240	1.2	3.44
12	0805	24.0	27.9	220	260	1.3	1.87
13	0810	24.0	28.0	140	100	0.8	5.80
14	0805	23.9	28.0	290	150	2.5	4.20
15	0800	23.9	28.1	370	260	1.2	4.91
18	0810	72.1	84.2	280	290	0.9	3.24
19	0815	24.0	27.9	280	190	0.9	0.98
20	0800	23.7	27.6	70	60	0.8	2.72
21	0805	24.0	28.4	90	120	0.5	6.49
22	0815	24.1	28.5	370	190	1.3	5.13
26	0802	95.7	111.7	150	150	1.2	5.57
27	0820	24.3	28.5	120	200	1.2	12.64
28	0800	23.6	27.8	240	220	0.8	4.02
29	0800	23.9	30.3	140	140	0.7	2.55
Average				226	172	1.6	5.7
Range of counting errors (2σ)							
Maximum				34	30	0.8	0.3
Minimum				15	14	0.2	0.1

[a] Sample period and volume does not apply to this column.

the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon–222 (p.m.) concentrations are uncorrected for any radon–220 daughter interferences. Radon–220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon–222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter.

The data are now computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the periods November 6–December 1, 1961, and December 4–December 29, 1961, appear in tables 1 and 2 respectively.

REFERENCE

Setter, L. R. and G. I. Coats "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal, 22*, No. 1, Feb. 1961.

Radioactivity Measurements In Surface Air

U.S. Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian (West) have been made since 1956. Sampling locations are shown by figure 1. This program is operated by the U.S. Naval Research Laboratory (NRL) with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile which have made the actual sample collections and forwarded them to NRL for analysis. Partial financial support of this program is provided by the Division of Biology and Medicine, U.S. Atomic Energy Commission.

The sampling procedure involves drawing air

FIGURE 1.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

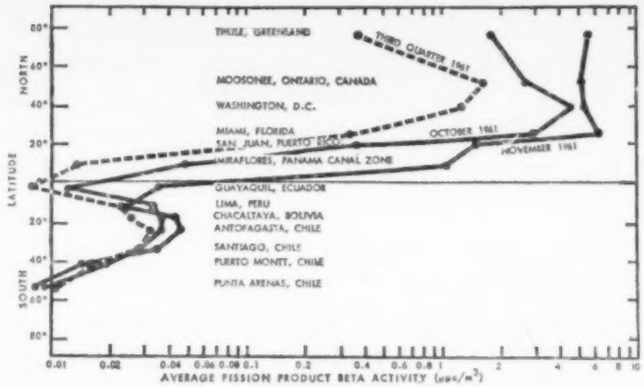

FIGURE 2.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST), OCTOBER AND NOVEMBER 1961

continuously at a rate of approximately 1200 cubic meters per day through high efficiency filters 8 inches in diameter, using positive displacement blowers. Due to the decrease of radioactivity levels during 1960 and 1961, it became necessary to change the sampling period from a daily to a weekly basis at most stations. After the sample is removed, it is forwarded immediately to NRL for assay of gross beta activity two weeks after collection.

The daily records of fission product beta activity during the months indicated are presented in tables 1 and 2; and the radioactivity profiles along the 80th Meridian (West) for the

TABLE 1.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, OCTOBER 1961

[Disintegrations/minute per cubic meter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	Mauna Loa, Hawaii	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland	San Juan, P. R.
1	0.02	0.04	0.08	0.06	0.04	0.05	0.02	0.05	0.37	5.86	11.4	3.54	9.30	0.16
2	0.02	0.04	0.08	0.06	0.04	0.05	0.02	0.05	0.37	5.86	11.4	1.23	9.30	0.16
3	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.71	2.44	0.16
4	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	11.3	2.44	0.16
5	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	----------	2.44	----------
6	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.04	2.44	----------
7	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.04	2.44	----------
8	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.04	2.44	----------
9	0.01	0.04	0.05	0.08	0.05	0.06	0.02	0.11	----------	7.40	10.6	6.04	2.44	----------
10	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	----------	3.12	7.79	6.04	2.43	0.35
11	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	----------	3.12	7.79	8.00	2.43	0.35
12	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	----------	3.12	7.79	6.13	2.43	0.35
13	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	1.69	3.12	7.79	1.18	2.43	0.35
14	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	1.69	3.12	7.79	4.86	2.43	0.35
15	0.03	0.04	0.06	0.09	0.10	0.09	0.03	0.05	1.69	3.12	7.79	9.51	2.43	0.35
16	0.03	0.05	0.06	0.09	0.10	0.09	0.03	0.05	1.69	3.12	7.79	5.75	2.43	0.35
17	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	5.75	2.43	1.03
18	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	2.27	3.21	1.03
19	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	3.52	3.21	1.03
20	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	3.84	3.21	1.03
21	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	6.62	3.21	1.03
22	0.02	0.05	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	8.35	3.21	1.03
23	0.02	0.04	0.07	0.08	0.10	0.07	0.03	0.12	0.44	11.1	9.41	10.9	3.21	1.03
24	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	11.2	3.21	1.29
25	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	11.6	4.12	1.29
26	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	6.01	4.12	1.29
27	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	1.90	4.12	1.29
28	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	2.60	4.12	1.29
29	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	4.36	4.12	1.29
30	0.02	0.04	0.07	0.08	0.07	0.09	0.03	0.15	1.57	5.20	9.50	4.25	4.12	1.29
31	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.50	7.48	----------	16.3	1.17
Mean (dpm/m³)	0.019	0.043	0.063	0.081	0.079	0.074	0.027	0.108	1.267	6.61	9.40	5.92	3.82	0.788
Mean (μμc/m³)	0.009	0.019	0.028	0.036	0.036	0.033	0.012	0.049	0.571	2.98	4.23	2.66	1.72	0.355

TABLE 2.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NOVEMBER 1961

[Disintegrations/minute per cubic meter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	Mauna Loa, Hawaii	Miami, Florida	Washington D. C.	Moosonee, Ontario, Canada	Thule, Greenland	San Juan, P. R.
1	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	7.41	16.40	1.17
2	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	4.43	16.40	1.17
3	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	----------	16.40	1.17
4	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	15.0	16.40	1.17
5	0.01	0.06	0.05	0.07	0.12	0.03	0.03	0.25	5.04	5.55	7.48	10.8	16.40	1.17
6	0.01	0.06	0.05	0.07	0.12	0.03	0.03	----------	5.04	5.55	7.48	1.62	16.40	1.17
7	----------	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	9.64	7.35	1.40
8	----------	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	15.0	7.35	1.40
9	----------	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	4.85	7.35	1.40
10	----------	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	18.6	7.35	1.40
11	----------	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	12.8	7.35	1.40
12	----------	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	17.0	7.35	1.40
13	----------	0.01	0.09	0.10	0.05	0.03	0.05	0.28	3.70	19.9	17.8	7.96	7.35	1.40
14	----------	----------	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	54.0	----------	3.61
15	----------	----------	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	42.3	11.2	3.61
16	----------	----------	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	11.9	11.2	3.61
17	----------	----------	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	----------	11.2	3.61
18	----------	----------	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	6.69	11.2	3.61
19	----------	----------	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	5.91	11.2	3.61
20	----------	----------	0.11	0.11	0.08	0.12	0.08	2.53	14.0	9.30	9.07	4.28	11.2	3.61
21	----------	----------	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	----------	11.2	7.62
22	----------	----------	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	16.3	11.8	7.62
23	----------	----------	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	12.5	11.8	7.62
24	----------	----------	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	4.35	11.8	7.62
25	----------	----------	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	5.27	11.8	7.62
26	----------	----------	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	6.55	11.8	7.62
27	----------	----------	0.07	0.09	0.11	0.04	0.14	6.35	4.97	15.3	10.9	1.30	11.8	7.62
28	----------	0.04	----------	0.19	0.15	0.06	0.11	0.60	10.9	20.6	11.1	3.50	14.5	3.50
29	----------	0.04	----------	0.19	0.15	0.06	0.11	0.60	10.9	20.6	11.1	4.32	14.5	3.50
30	----------	0.04	----------	0.19	0.15	0.06	0.11	0.60	10.9	20.6	11.1	3.22	14.5	3.50
Mean (dpm/m³)	0.010	0.034	0.081	0.103	0.095	0.056	0.080	2.31	7.39	13.55	11.42	11.39	11.81	3.53
Mean (μμc/m³)	0.005	0.015	0.036	0.046	0.043	0.025	0.036	1.04	3.33	6.11	5.14	5.13	5.32	1.59

TABLE 3.—RADIOCHEMICAL ANALYSES OF MONTHLY COMPOSITE AIR-FILTER COLLECTIONS

Month 1960	Activity (μμc/m³)[a]									
	Gross β	Ce^{141}	Sr^{89}	Y^{91}	Ce^{144}	Pm^{147}	Sr^{90}	Cs^{137}	W^{185b}	Pb^{210}
Thule, Greenland (Latitude 76°35′ North, Longitude 68°35′ West, Elevation 259 Meters)										
January	0.13	[d]	*	*	0.0026	0.0089	0.00278	0.0058	0.00115	—[e]
March	0.16	*	(0.0008)[c]	*	0.0253	0.0147	0.00419	0.0060	0.00063	—
May	0.10	*	(0.0003)	*	0.0164	0.0082	0.00320	0.0064	0.00023	—
July	0.081	*	*	*	0.0123	0.0078	0.00277	0.0054	0.00019	—
September	0.032	*	*	*	0.0042	0.0025	0.00105	0.0019	—	0.0026
November	0.027	*	*	*	0.0036	0.0028	0.00099	0.0017	—	0.0100
Moosonee, Ontario, Canada (Latitude 51°16′ North, Longitude 80°39′ West, Elevation 10 Meters)										
January	0.090	*	*	*	0.0129	0.0052	0.00159	0.0035	0.00059	—
March	0.18	*	(0.0017)	*	0.0258	0.0106	0.00386	0.0076	0.00078	—
May	0.13	*	(0.0004)	*	0.0259	0.0135	0.00491	0.0099	0.00025	—
July	0.12	*	*	*	0.0204	0.0124	0.00448	0.0084	0.00017	—
September	0.054	*	*	*	0.0065	0.0048	0.00155	0.0031	—	0.0095
November	0.036	*	*	*	0.0030	0.0021	0.00080	0.0015	—	0.0123
Washington, D. C. (Latitude 38°50′ North, Longitude 76°57′ West, Elevation 88 Meters)										
January	0.11	*	(0.0006)	*	0.0177	0.0067	0.00219	0.0047	0.00080	—
March	0.19	*	(0.0019)	*	0.0283	0.0131	0.00423	0.0091	0.00071	—
May	0.22	*	(0.0006)	*	0.0387	0.0198	0.00757	0.0154	0.00045	—
July	0.15	*	*	*	0.0303	0.0203	0.00689	0.0133	0.00020	—
September	0.081	*	*	*	0.0097	0.0080	0.00245	0.0045	—	0.0216
November	0.063	*	*	*	0.0062	0.0037	0.00159	0.0033	—	0.0283
Miami, Florida (Latitude 25°49′ North Longitude 80°17′ West, Elevation 4 Meters)										
January	0.19	*	(0.0022)	*	0.0377	0.0159	0.00478	0.0059	0.00191	—
March	0.44	0.037	0.0215	0.0137	0.0455	0.0199	0.00680	0.0070	0.00104	—
May	0.24	*	(0.00009)	*	0.0405	0.0222	0.00784	0.0115	0.00046	—
July	0.059	*	*	*	0.0103	0.0068	0.00216	0.0028	0.00013	—
September	0.032	*	*	*	0.0037	0.0022	0.00080	0.0011	—	0.0036
November	0.063	*	*	*	0.0085	0.0064	0.00228	0.0023	—	0.0071

TABLE 3.—RADIOCHEMICAL ANALYSES OF MONTHLY COMPOSITE AIR-FILTER COLLECTIONS—Continued

Month 1960	Activity ($\mu\mu c/m^3$)[a]									
	Gross β	Ce^{141}	Sr^{89}	Y^{91}	Ce^{144}	Pm^{147}	Sr^{90}	Cs^{137}	W^{185}[b]	Pb^{210}
Mauna Loa, Hawaii (Latitude 19°28′ North, Longitude 155°36′ West, Elevation 3394 Meters)										
January	0.15	*	*	*	0.0309	0.0128	0.00419	0.0084	0.00149	—
March	0.52	0.060	0.064	0.0283	0.0381	0.0163	0.00626	0.0114	0.00073	—
May	0.14	*	(0.0010)	*	0.0273	0.0148	0.00559	0.0105	0.00035	—
July	0.14	*	—	—	0.0256	0.0154	—	—	0.00032	—
September	0.063	*	*	*	0.0084	0.0050	0.00183	0.0036	—	0.0058
November	0.045	*	*	*	0.0062	0.0048	0.00173	0.0033	—	0.0073
Miraflores, Panama Canal Zone (Latitude 9°00′ North, Longitude 79°35′ West, Elevation 10 Meters)										
January	0.077	*	*	(0.0005)	0.0114	0.0061	0.00146	0.00191	0.00057	—
March	2.50	0.505	0.231	0.189	0.0680	0.0200	0.00387	0.00070	0.00037	—
May	0.027	*	(0.00014)	*	0.0029	0.00157	0.00062	0.00114	0.00008	—
July	0.023	*	*	*	0.0025	0.00160	0.00054	0.00086	0.00004	—
September	0.014	*	*	*	0.0047	0.00041	0.00019	0.00026	—	0.0022
November	0.014	*	*	*	0.00072	0.00053	0.00019	0.00027	—	0.0033
Guayaquil, Ecuador (Latitude 2°10′ South, Longitude 79°52′ West, Elevation 7 Meters)										
January	0.027	*	*	*	0.0035	0.0016	0.00053	0.0011	0.00020	—
March	0.21	0.082	0.0464	0.0293	0.0112	0.0034	0.00077	0.0019	0.00010	—
May	0.032	*	(0.00009)	(0.0009)	0.0018	0.0010	0.00039	0.00076	—	0.0130
July	—	—	—	—	—	—	—	—	—	—
September	0.018	*	*	*	0.0012	0.00077	0.00033	0.00072	—	0.0037
November	0.027	*	*	*	0.0035	0.0024	0.00125	0.0023	—	0.0061
Lima, Peru (Latitude 12°06′ South, Longitude 77°01′ West, Elevation 134 Meters)										
January	0.018	*	*	*	0.0028	0.00135	0.00044	0.00094	0.00019	—
March	0.023	(0.0020)	0.0010	0.00064	0.0029	0.00136	0.00052	0.00096	0.00014	—
May	0.009	*	*	*	0.00058	(0.00049)	0.00014	0.00025	—	0.0033
July	0.018	—	—	—	—	—	—	—	—	—
September	0.027	*	*	*	0.0035	0.0023	0.00097	0.00169	—	0.0017
November	0.023	*	*	*	0.0029	0.0022	0.00091	0.00167	—	0.0033
Chacaltaya, Bolivia (Latitude 17°10′ South, Longitude 68°15′ West, Elevation 5220 Meters)										
January	0.014	*	*	*	0.0010	0.0058	0.00018	0.00061[b]	0.00055	—
March	0.045	(0.0017)	(0.0008)	*	0.0031	0.00187	0.00059	0.00115	0.00018	—
May	0.041	*	*	*	0.0026	0.00147	0.00067	0.00100	—	0.0083
July	0.041	—	—	—	—	—	—	—	—	—
September	0.041	*	*	*	0.0034	0.0023	0.00091	0.00176	—	0.0117
November	0.041	*	*	*	0.0027	0.0021	0.00084	0.00172	—	0.0107
Antofagasta, Chile (Latitude 23°37′ South, Longitude 70°16′ West, Elevation 519 Meters)										
January	0.045	*	*	*	0.0066	0.0030	0.00100	0.0024[b]	0.00047	—
March	0.058	*	(0.0009)	(0.0005)	0.0070	0.0035	0.00137	0.0029	0.00027	—
May	0.032	*	*	*	0.0036	0.0021	0.00080	0.0015	—	0.0132
July	0.045	*	*	*	0.0061	0.0036	0.00164	0.0030	—	0.0061
September	0.063	*	*	*	0.0084	0.0055	0.00234	0.0029	—	0.0014
November	0.050	*	*	*	0.0068	0.0050	0.00205	0.0040	—	0.0051
Santiago, Chile (Latitude 33°27′ South, Longitude 70°42′ West, Elevation 520 Meters)										
January	0.054	*	*	*	0.0077	0.0042	0.00129	0.0026	0.00053	—
March	0.063	*	*	*	0.0078	0.0041	0.00162	0.0024	0.00034	—
May	0.036	*	*	*	0.0031	0.0018	0.00068	0.0013	—	0.0128
July	0.036	*	*	*	0.0044	0.0027	0.00114	0.0016	—	0.0075
September	0.059	*	*	*	0.0074	0.0046	0.00211	0.0042	—	0.0044
November	0.050	*	*	*	0.0076	0.0054	0.00238	0.0048	—	0.0060
Puerto Montt, Chile (Latitude 41°27′ South, Longitude 72°57′ West, Elevation 5 Meters)										
January	0.041	*	*	*	0.0074	0.0038	0.00128	0.0020	0.00068	—
March	0.045	*	*	*	0.0068	0.0034	0.00140	0.0024	0.00022	—
May	0.023	*	*	*	0.0037	0.0021	0.00079	0.00130	—	0.0029
July	0.009	*	*	*	0.0016	0.0010	0.00041	0.00072	—	0.0012
September	0.023	*	*	*	0.0031	0.0018	0.00100	0.00127	—	0.0013
November	—	—	—	—	—	—	—	—	—	—
Punta Arenas, Chile (Latitude 53°08′ South, Longitude 70°53′ West, Elevation 3 Meters)										
January	0.014	*	*	*	0.0028	0.0016	0.00060	0.00114	0.00027	—
March	0.018	*	*	*	0.0035	0.0018	0.00073	0.00120	0.00023	—
May	0.023	*	*	*	0.0028	0.0019	0.00066	0.00135	—	0.0020
July	0.009	*	*	*	0.0014	0.0010	0.00036	0.00067	—	0.0007
September	0.014	*	*	*	0.0024	0.0016	0.00071	0.00132	—	0.0017
November	0.009	*	*	*	0.0013	0.0012	0.00045	(0.0010)	—	0.0006

[a] Counting error <1% (σ) unless otherwise indicated.
[b] Counting error in range of 1–5% (σ).
[c] ( ) indicates counting error >5% (σ).
[d] * indicates activity too low for measurement.
[e] — indicates no analytical results reported.

same months are shown in figure 2. This figure illustrates the data plotted in semilogarithmic coordinates. The abscissa is expressed in micromicrocuries per cubic meter of surface air.

A summary of the radiochemical analyses of monthly composite air-filter collections made during 1960 is presented in table 3 in $\mu\mu c/m^3$ of standard air.[1] All activities (except gross beta) are corrected for decay to the midpoint of the month listed. Unless otherwise indicated, the counting errors were less than $\pm$ 1 percent at the 68.3 percent confidence level (σ).

[1] Lockhart, Jr., L. B., R. L. Patterson, Jr., A. W. Saunders, Jr., and R. W. Black, "Fission Product Radioactivity in the Air Along the 80th Meridian (West) During 1960," *NRL Report 5692*, October 24, 1961.

SECTION II.—FOOD, OTHER THAN MILK

Tri-City Diet Study[1]

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Approximately every three months since May 1960, estimates of the strontium–90 content of average diets for individuals living in New York City, San Francisco, and Chicago have been made by the Health and Safety Laboratory. Results obtained from analyses of foods purchased in the first four samplings have been reported in *Quarterly Summary Reports, HASL–105, 111, 113, and 115* and presented in the April, June, October, and December 1961 *Radiological Health Data.*

Selected foods, representing 19 food categories, are purchased at each of these three cities about every three months and are analyzed for strontium–90 and stable calcium. Using data from the U.S. Department of Agriculture, "Household Food Survey of 1955," the annual consumption by an individual can be grouped into the same 19 food categories. The annual dietary intake of strontium–90 and calcium can then be estimated by summing the contributions from each category. Some food types are assumed to be representative of larger food categories, such as liquid milk for dairy products in general. Hence, in the tables that follow, the values shown for food consumption may not be directly related to the original data in the source document. Further details of the food purchase plan for this study were presented in *HASL–90.*

[1] Data from *Quarterly Summary Report, HASL–117,* December 30, 1961.

Results obtained from the fifth sampling of foods are presented in table 1. Table 2 presents a summary of the annual intake of strontium–90 from all five samplings. The data in these tables show no significant changes in the relative contributions of the various foods to the total intake, or in the total intake of strontium–90 since the fourth sampling. Contributions of strontium–90 from tap water are not included in these tables, but measurements during 1960 and 1961 indicate the contribution would be in the range of 100 to 200 $\mu\mu c$ Sr^{90} per year. It is assumed in making this estimate that the average daily intake of tap water is 1.2 liters.

Using the totals given in table 1, the following average concentrations in $\mu\mu c$ Sr^{90}/gm Ca may be calculated for the annual intake: New York, 11.0; Chicago, 5.7; San Francisco, 2.9. This calculation was based on calcium data obtained from the first two sampling periods. Despite the fact that there is some variability in the results obtained from analyses of individual food categories, the total intake of calcium was calculated to be 383 grams per person with a standard deviation of less than 5 percent. Because of the relative constancy of the average annual intake of calcium due to its strong dependence on the relatively constant calcium content of milk, analyses of food categories, other than milk, for calcium were discontinued after the second sampling.

TABLE 1.—STRONTIUM-90 LEVELS OF DIET—FIFTH SAMPLING

Food type	Annual consumption	New York City May 1961		Chicago July 1961		San Francisco June 1961	
	(kg/yr)	μμc/kg	μμc/yr	μμc/kg	μμc/yr	μμc/kg	μμc/yr
Whole grain products	11	7.8	86	7.9	87	5.1	56
Refined grain products	37	10.3	381	6.2	229	2.1	79
Refined grain flour	43	5.4	232	6.0	258	2.8	120
Milk, liquid	221	8.9	1967	4.5	995	1.9	420
Potatoes	45	1.4	63	0.9	41	1.3	57
Macaroni	3	3.5	11	3.7	11	3.0	9
Beans, dried	3	16.7	50	15.2	46	7.6	23
Vegetables, canned	20	3.1	62	4.0	80	1.7	33
Vegetables, fresh	43	11.4	490	2.4	103	1.1	47
Vegetables, root	17	25.2	428	3.1	53	2.7	46
Fruit, canned	26	1.0	26	0.9	23	1.3	33
Fruit juices	19	2.3	44	2.2	42	1.6	30
Fruit, fresh	68	4.1	279	0.7	48	1.2	81
Rice	3	1.2	4	1.4	4	1.1	3
Eggs	16	1.7	27	2.2	35	1.4	22
Fish, fresh	8	0.6	5	0.4	3	0.7	6
Fish, shell	1	0.8	1	0.5	1	2.7	3
Meat	73	0.6	44	0.8	58	0.6	45
Poultry	17	0.8	14	3.8	65	0.8	13
Total annual intake			4214		2182		1129

TABLE 2.—SUMMARY OF STRONTIUM-90 ANNUAL INTAKE

[μμc/year]

Food type	San Francisco					Chicago					New York City				
	March 1960	Aug 1960	Jan 1961	Mar 1961	June 1961	May 1960	Sept 1960	Nov 1960	April 1961	July 1961	March 1960	June 1960	Oct 1960	Feb 1961	May 1961
Whole grain products	32	121	16	138	56	219	180	168	183	87	228	310	187	70	86
Refined grain products	95	167	144	242	79	485	337	185	358	229	352	377	211	322	381
Refined grain flour	156	172	86	23	120	486	340	237	351	258	447	397	215	251	232
Milk, liquid	928	420	398	464	420	1348	2138	1392	1164	995	2100	2431	1370	1735	1967
Potatoes	198	27	166	126	57	131	126	58	189	41	441	144	248	207	63
Macaroni	11	12	9	10	9	29	23	15	12	11	22	14	21	11	11
Beans, dried	19	11	13	4	23	5	22	48	61	46	6	7	25	58	50
Vegetables, canned	37	16	24	16	33	94	108	116	132	80	84	58	106	50	62
Vegetables, fresh	98	129	86	103	47	474	237	271	416	103	237	585	757	151	490
Vegetables, root	98	12	48	61	46	116	58	51	155	53	90	88	82	75	428
Fruit, canned	37	49	91	25	33	49	23	29	29	23	39	47	34	58	26
Fruit, juices	45	38	49	38	30	67	38	57	66	42	29	57	61	43	44
Fruit, fresh	46	68	122	157	81	408	109	279	[a]279	48	20	129	537	442	279
Rice	5	6	5	5	3	5	4	3	6	4	7	3	7	0	4
Eggs	47	37	37	33	22	51	30	22	26	35	170	32	51	21	27
Fish, fresh	2	2	2	2	6	8	1	21	28	3	2	2	1	5	5
Fish, shell	1	1	1	4	3	1	1	1	4	1	2	1	1	1	1
Meat	139	37	44	21	45	73	73	44	23	58	73	66	66	47	44
Poultry	13	24	36	11	13	22	43	15	11	65	27	12	14	6	14
Total annual intake	2007	1349	1378	1482	1129	4074	2991	3012	3493	2182	4376	4760	3992	3533	4214

[a] Estimated from November 1960 sampling.

SECTION III.—MILK

Milk Monitoring Program

Division of Radiological Health, Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical proficiencies. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were operated concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

Raw milk sampling results reported for June 1961 in the November 1961 *Radiological Health Data* were the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *Radiological Health Data* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

Surveillance of pasteurized milk is currently conducted at 61 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies, who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis. The former analyzes samples from the 31 states generally east of the Mississippi River, and the latter analyzes samples from the western states. Publication of data follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the levels of radioactivity of samples of pasteurized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within virtually all states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

During the second week in September, when increased levels of gross beta radioactivity in air were reported by the Radiation Surveillance Network, the frequency of milk sampling was accelerated at selected stations. Daily sam-

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS

pling of pasteurized milk, with analyses for iodine–131 content, was initiated on September 19, 1961, at six selected stations.

Iodine–131, cesium–137, and barium–140 are determined by gamma scintillation spectroscopy, while strontium–89 and strontium–90 are determined following radiochemical separation. The cesium–137 and barium–140 data were determined on most of the milk samples obtained for iodine–131 analyses by the Southwestern Radiological Health Laboratory. The minimum level of detection for strontium–89 is 5 μμc/liter, and for barium–140 and iodine–131, 10 μμc/liter.

Table 1 presents a summary of all available analyses. The numbers in parentheses indicate the number of samples involved in each average, and are a guide to the reliability of the average for the month. When a radionuclide was not detectable, one-half the minimum level of detection was used for averaging.

The sampling schedule in effect during most of October 1961 was presented in the January 1962 *Radiological Health Data*. With the conclusion of the Soviet Union's 1961 series of atmospheric tests, the iodine–131 levels are more predictable and it becomes necessary for the analytical program to shift to other radionuclides. This need is emphasized by the fact that the analytical procedures become more difficult as the levels of activity become lower and the longer lived nuclides increase in relative importance. Therefore, beginning in December 1961, the following sampling schedule became effective:

1. Six daily sampling stations (St. Louis, Seattle, New York, Chicago, Boston, and New Orleans) to be maintained so that the pattern of normal decline in iodine–131 content of milk at these points may be carefully studied.

2. Any station in the program, not included in the daily sampling schedule where the iodine–131 level exceeds 100 μμc/liter at the time of sampling, to be placed on a two samples per week schedule until this concentration drops and remains below 100 for two consecutive weeks.

3. All other sampling stations to be placed on a weekly sampling schedule.

4. A full analysis to be completed on a weekly

TABLE 1.—RADIOACTIVITY IN MILK—PASTEURIZED MILK AREA SAMPLING STATIONS, OCTOBER 1961

[Average concentrations in μμc/liter]

Area		Calcium (grams/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average
Montgomery	Ala.	[c] NA	1.20 (1)	NA	15 (1)	NA	7 (1)	NA	30 (1)	NA	<5 (1)	NA	10 (1)
Palmer	Alaska	1.12	[a]1.11 (3)	[b]—	105 (4)	7	16 (4)	—	330 (9)	10	15 (6)	—	100 (6)
Phoenix	Ariz.	1.04	1.03 (1)	—	<5 (1)	4	3 (1)	—	60 (3)	<5	10 (3)	—	<10 (3)
Little Rock	Ark.	1.21	1.16 (2)	—	35 (2)	16	15 (2)	—	120 (2)	10	30 (1)	—	30 (2)
Sacramento	Calif.	1.10	1.11 (4)	<5	10 (5)	5	8 (5)	<10	20 (15)	10	10 (12)	<10	<10 (15)
San Francisco	Calif.	1.06	1.13 (1)	—	<5 (1)	4	3 (1)	—	20 (2)	10	10 (2)	—	10 (2)
Denver	Colo.	1.05	1.08 (4)	<5	15 (4)	5	6 (4)	20	90 (17)	10	15 (16)	<10	20 (16)
Hartford	Conn.	1.15	1.18 (2)	—	30 (2)	8	10 (2)	—	60 (3)	15	10 (1)	—	50 (2)
Wilmington	Del.	1.18	1.17 (2)	—	45 (2)	10	15 (2)	—	60 (3)	15	<5 (1)	—	30 (2)
Washington	D. C.	1.14	1.16 (5)	5	35 (5)	7	8 (5)	20	60 (25)	10	5 (1)	<10	30 (5)
Tampa	Fla.	1.24	1.23 (3)	<5	15 (3)	5	5 (3)	20	40 (10)	85	75 (1)	<10	30 (3)
Atlanta	Ga.	1.23	1.20 (4)	<5	20 (4)	10	12 (4)	30	80 (22)	15	NA	<10	30 (4)
Honolulu	Hawaii	1.06	1.04 (1)	—	<5 (1)	6	4 (1)	—	20 (3)	10	20 (3)	—	10 (3)
Idaho Falls	Idaho	1.05	1.11 (1)	—	35 (1)	6	8 (1)	—	140 (3)	5	15 (3)	—	20 (3)
Chicago	Ill.	1.14	1.18 (4)	10	55 (4)	5	9 (4)	40	150 (22)	15	NA	<10	60 (4)
Indianapolis	Ind.	1.18	1.22 (2)	—	30 (2)	6	7 (2)	—	70 (2)	10	<5 (1)	—	10 (2)
Des Moines	Iowa	1.04	1.08 (1)	—	65 (1)	7	15 (1)	—	290 (3)	10	15 (3)	—	40 (3)
Wichita	Kans.	1.08	1.08 (4)	—	30 (4)	11	11 (4)	—	130 (22)	5	15 (18)	—	20 (18)
Louisville	Ky.	1.15	1.18 (2)	—	15 (2)	9	11 (2)	—	90 (3)	5	<5 (1)	—	20 (2)
New Orleans	La.	1.28	1.27 (5)	5	40 (5)	13	15 (5)	30	80 (22)	25	15 (1)	<10	30 (5)
Portland	Maine	1.19	1.22 (1)	10	120 (1)	9	11 (1)	10	120 (2)	30	10 (1)	<10	70 (1)
Baltimore	Md.	1.16	1.16 (2)	—	30 (2)	10	8 (2)	—	70 (2)	15	<5 (1)	—	20 (2)
Boston	Mass.	1.17	1.18 (2)	—	120 (2)	10	12 (2)	—	130 (3)	30	20 (1)	—	60 (2)
Detroit	Mich.	1.14	1.18 (2)	—	50 (2)	6	7 (2)	—	210 (2)	5	<5 (1)	—	50 (2)
Grand Rapids	Mich.	1.18	1.18 (2)	—	75 (2)	7	7 (2)	—	90 (2)	5	<5 (1)	—	40 (2)
Minneapolis	Minn.	1.07	1.04 (1)	—	170 (1)	9	17 (1)	—	340 (2)	15	25 (2)	—	90 (2)
Jackson	Miss.	1.26	1.28 (1)	5	40 (5)	12	12 (5)	50	90 (21)	15	10 (1)	<10	30 (5)
Pascagoula	Miss.	[c] NA	1.27 (5)	NA	30 (5)	NA	14 (5)	70	100 (22)	NA	<5 (1)	NA	40 (5)
Kansas City	Mo.	1.04	1.07 (6)	—	85 (1)	9	7 (1)	—	150 (5)	5	15 (2)	—	20 (2)
St. Louis	Mo.	1.07	1.07 (7)	10	30 (6)	8	10 (6)	60	160 (25)	10	15 (18)	<10	20 (18)
Helena	Mont.	1.05	1.13 (1)	—	15 (1)	7	13 (1)	—	160 (2)	15	25 (2)	—	20 (2)
Omaha	Nebr.	1.13	1.06 (4)	—	125 (4)	8	15 (4)	—	250 (19)	10	15 (14)	—	80 (14)
Manchester	N. H.	1.19	1.21 (2)	—	40 (2)	9	12 (2)	—	100 (3)	40	30 (1)	—	60 (2)
Trenton	N. J.	1.14	1.21 (2)	—	40 (2)	8	8 (2)	—	90 (2)	10	<5 (1)	—	20 (2)
Albuquerque	N. Mex.	1.09	1.02 (1)	—	<5 (1)	3	10 (1)	—	30 (2)	5	10 (2)	—	<10 (2)
Buffalo	N. Y.	1.13	1.12 (2)	—	45 (2)	7	11 (2)	—	100 (3)	10	<5 (1)	—	30 (2)
New York	N. Y.	1.13	1.13 (5)	5	50 (5)	9	8 (5)	50	100 (25)	15	<5 (1)	10	40 (5)
Syracuse	N. Y.	1.15	1.17 (2)	—	90 (2)	6	8 (2)	—	140 (3)	10	10 (1)	—	70 (2)
Charlotte	N. C.	1.22	1.26 (2)	—	30 (2)	12	9 (2)	—	40 (3)	10	<5 (1)	—	10 (2)
Minot	N. D.	1.04	1.08 (1)	5	40 (1)	7	12 (1)	20	140 (1)	10	15 (1)	<10	<10 (1)
Cincinnati	Ohio	1.20	1.22 (2)	—	25 (2)	9	6 (2)	—	100 (2)	<5	<5 (1)	—	30 (2)
Cleveland	Ohio	1.17	1.20 (2)	—	40 (2)	7	7 (2)	—	100 (2)	5	<5 (1)	—	30 (2)
Oklahoma City	Okla.	1.19	1.14 (2)	—	30 (2)	6	6 (2)	—	90 (2)	5	20 (1)	—	10 (2)
Portland	Oreg.	1.10	1.11 (1)	—	<5 (1)	11	12 (1)	—	60 (2)	20	25 (2)	—	10 (2)
Philadelphia	Pa.	1.18	1.22 (2)	—	35 (2)	8	7 (2)	—	80 (2)	15	<5 (1)	—	<10 (2)
Pittsburgh	Pa.	1.15	1.16 (2)	—	65 (2)	11	9 (2)	—	90 (3)	10	<5 (1)	—	40 (2)
San Juan	P. R.	1.17	1.22 (2)	—	10 (2)	4	7 (2)	—	20 (2)	10	<5 (1)	—	20 (2)
Providence	R. I.	1.15	1.18 (2)	—	60 (2)	12	10 (2)	—	80 (3)	30	15 (1)	—	40 (2)
Charleston	S. C.	1.22	1.23 (5)	<5	15 (5)	11	11 (5)	30	60 (23)	30	15 (1)	<10	20 (5)
Chattanooga	Tenn.	1.28	1.22 (1)	—	25 (1)	12	10 (1)	—	80 (2)	15	10 (1)	—	<10 (1)
Memphis	Tenn.	1.23	1.24 (2)	—	30 (2)	12	7 (2)	—	160 (2)	5	<5 (1)	—	10 (2)
Austin	Tex.	1.20	1.17 (4)	<5	10 (4)	2	4 (4)	10	30 (31)	<5	NA	<10	<20 (4)
Dallas	Tex.	1.17	1.23 (1)	<5	20 (1)	6	8 (1)	10	40 (1)	10	NA	<10	20 (1)
Salt Lake City	Utah	1.16	1.11 (5)	5	25 (4)	4	7 (4)	50	120 (22)	10	15 (17)	<10	20 (17)
Burlington	Vt.	1.14	1.18 (2)	—	50 (2)	8	8 (2)	—	100 (3)	15	20 (1)	—	50 (2)
Norfolk	Va.	1.22	1.24 (2)	—	85 (2)	9	8 (2)	—	80 (3)	10	<5 (1)	—	30 (3)
Seattle	Wash.	1.06	1.10 (5)	10	75 (6)	11	15 (6)	<10	120 (25)	15	30 (20)	<10	50 (20)
Spokane	Wash.	1.04	1.18 (1)	—	10 (1)	9	6 (1)	—	120 (3)	20	25 (3)	—	10 (3)
Charleston	W. Va.	1.17	1.17 (2)	—	70 (2)	11	8 (2)	—	60 (3)	10	<5 (1)	—	30 (2)
Milwaukee	Wis.	1.17	1.17 (5)	—	40 (5)	5	9 (5)	—	150 (31)	10	10 (1)	—	40 (5)
Laramie	Wyo.	1.04	1.08 (1)	—	<5 (1)	7	8 (1)	—	40 (3)	15	20 (3)	—	20 (3)
Network average[d]		1.14	1.16	5	40	8	9	30	100	15	15	<10	30

[a] Number in parentheses indicates total number of analyses reported during October.
[b] Dash indicates that the average concentration during the third quarter was reported to be less than the level of detection. The minimum level of detection for Sr^{90} is 5 μμc/liter, and for Ba^{140} and I^{131}, 10 μμc/liter. The samples were collected prior to the effect of Russian nuclear weapons testing.
[c] NA indicates no analysis made.
[d] Stations with dashes not included in network averages.

basis for all samples (stable calcium, strontium–89, strontium–90, cesium–137, barium–140, and iodine–131). For those stations where samples are collected more often than once a week, the laboratories will composite for the weekly analytical schedule as above, except for those radionuclides immediately determined by gamma scan on each sample as received.

All surveillance data will be subject to continuing review and evaluation to observe unusual patterns or levels which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing would, of course, require an immediate re-evaluation and readjustment of the sampling frequency and analytical schedule for this program.

Comparison of the results of the October

averages with the third quarter averages shows that the October stable calcium, strontium–90, and cesium–137 results are generally within anticipated variations. The analyses for strontium–89 and barium–140 show that the concentrations of these nuclides are increasing in pasteurized milk. The October iodine–131 levels show an increase over the previous month. The daily iodine–131 results for September and October were published in the November and December 1961 *Radiological Health Data*, respectively. The November daily results, published in the January 1962 issue show that the iodine–131 levels are declining.

Iodine-131 in Bovine Milk From Minnesota

Division of Environmental Sanitation
Minnesota Department of Health

The Minnesota State Department of Health, Division of Environmental Sanitation, initiated a small bovine milk surveillance network in September 1958. Analyses for strontium–90 were made on the samples from these network stations. These strontium–90 data have been published in the July and December 1960, and the June and October 1961 *Radiological Health Data*.

In October 1961, following the resumption of atmospheric weapons testing by the U.S.S.R., a special network of stations, shown in figure 1, was established for the collection of "grab" milk samples at milk processing plants. These samples were analyzed for radioiodine concentrations. The data are reported in table 1.

FIGURE 1.—MINNESOTA SAMPLING LOCATIONS FCR IODINE-131 IN BOVINE MILK

TABLE 1.—IODINE-131 LEVELS IN BOVINE MILK FROM MINNESOTA, OCTOBER–DECEMBER 1961

[Concentrations in $\mu\mu c$/liter]

Samples collected the week of	Bemidji	Duluth	Fergus Falls	Little Falls	Mankato	Minneapolis	Rochester	Worthington (vicinity)
October 16	130	170	40	240	130	200	100	80
30	370	440	130	290	60	280	300	220
November 13	70	160	30	40	140	130	50	120
20	60	40	<15	<15	30	110	40	120
27	20	<15	20	<15	<15	<15	<15	60
December 4	[a] <15	<15	<15	<15	<15	40	<15	70
11	<15	<15	<15	<15	<15	<15	<15	<15
18	<15	<15	<15	<15	<15	<15	<15	<15

[a] Lower limit of detection.

Radioactivity in Milk

Health and Safety Laboratory
U.S. Atomic Energy Commission

In 1954, the Health and Safety Laboratory began monitoring milk in New York City for strontium–90 in order to estimate the potential hazard resulting from the contamination of foods by fallout. Subsequently, monitoring was initiated at Mandan, North Dakota; Perry, New York; and Honolulu, Hawaii.

Prior to July 1960, strontium–89, strontium–90, and calcium were reported. Because of the low strontium–89 levels since July 1960, analyses for this nuclide were discontinued but were resumed again for July 1961 samplings. Strontium–89 was found to be still below the levels of detection. Table 1 presents the 1959 and 1960 averages as well as the May, June, and July 1961 data.[1] Data on strontium–90 in liquid and powdered milk for this period are presented graphically in figures 1 and 2.

[1] Data from *Quarterly Summary Report, HASL–117*, December 30, 1961.

TABLE 1.—STRONTIUM-90 AND CALCIUM IN MILK SAMPLES, MAY–JULY 1961

Sampling station and period	Strontium-90			Calcium		Sampling station and period	Strontium-90			Calcium	
	μμc/liter	μμc/kg	μμc/gm Ca	gm/liter	gm/kg		μμc/liter	μμc/kg	μμc/gm Ca	gm/liter	gm/kg
Perry, New York (powdered milk)						Mandan, North Dakota (powdered buttermilk)					
1959 average			8.0			1959 average			25.7		
1960 average			6.5			1960 average			15.0		
May 1961		71	6.6		10.7	May 1961		125	12.0		10.4
June 1961		59	5.9		9.9	June 1961		116	9.6		12.1
July 1961		62	6.3		9.9	July 1961		78	7.3		10.7
New York, New York (liquid milk)						Honolulu, Hawaii[1] (liquid milk)					
1959 average			11.0			1959 average			5.0		
1960 average			8.0			1960 average			3.2		
May 1961	8.9		8.1	1.10		May 1961	2.2		2.1	1.02	
							1.8		1.9	0.96	
June 1961	9.6		8.4	1.14		June 1961	1.6		1.6	0.96	
							2.6		2.6	0.98	
July 1961	8.6		7.0	1.23		July 1961	1.9		1.5	1.27	
							3.0		2.2	1.38	

[1] Two results per month represents milk from two dairies.

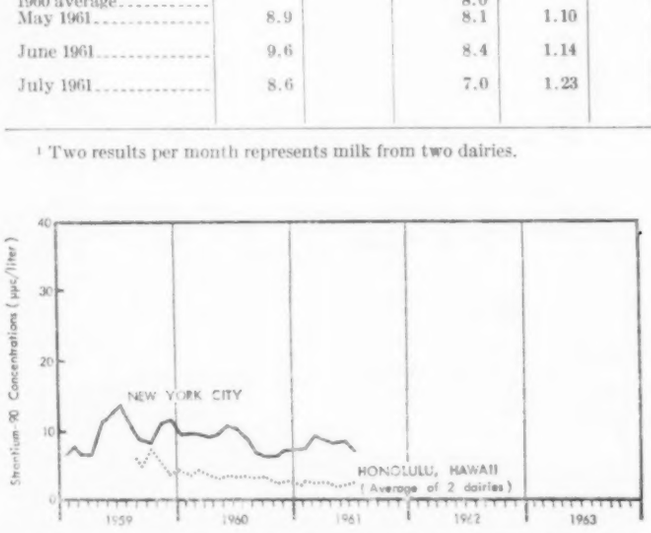

FIGURE 1.—STRONTIUM-90 IN LIQUID MILK SAMPLES, JANUARY 1959–JULY 1961

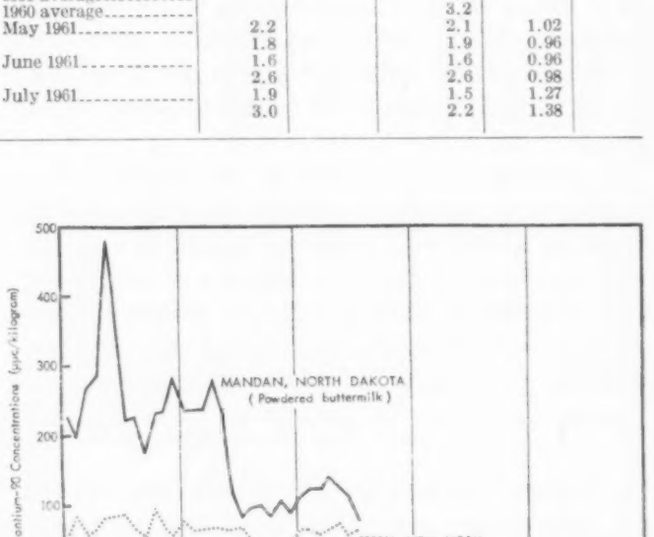

FIGURE 2.—STRONTIUM-90 IN POWDERED MILK SAMPLES, JANUARY 1959–JULY 1961

SECTION IV.—WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network operates under the provision of Section 4(c) of the Federal Water Pollution Control Act, which states ". . . The Secretary shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local agencies, and industrial organizations commenced operations in October 1957. As of December 1, 1961, there were 97 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids in raw surface samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere by the USSR has resulted in an increase in radioactivity of surface waters. Evidence obtained during October–December 1961 indicates a 5- to 10-fold increase in gross beta radioactivity of the surface waters over the 1960 average in some areas, particularly in North Central, Northeastern, and Eastern United States. The greater percentage of increase in the radioactivity is in the suspended solids.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each had one gross alpha determination per month.

The following changes were instituted on September 1, 1961, after the resumption of nuclear weapons testing:

1. Gross beta counts are to be made on all samples collected. (Compositing weekly samples for monthly or semimonthly gross alpha and beta counting will cease).
2. Beginning with samples collected October 1, 1961, strontium–90 determinations are to be made on a three months composite of weekly samples.

Gross alpha counts are to be made on one sample for each station each month, unless there is evidence of alpha activity. In the latter instance, an alpha determination will be made on a weekly or bi-weekly basis depending on what is considered the norm for a particular station.

All data reported in table 1 represent the average of all information available for the period indicated. Reported strontium–90 data are the results of determinations on three-month composite samples for a quarter ending in the month shown. The data were determined on analytical schedules in effect till September 1, 1961.

Additional information and data may be obtained from the following sources:

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication No. 663, Water Years 1957–58, 1958–59, 1959–60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D. C.
(2) "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167–169.
(3) Setter, L. R., J. E. Regnier, and A. Diephaus, "Radioactivity of Surface Waters in the United States," J. AWWA *51*, 1377 (1959).
(4) Straub, C. P., L. R. Setter, A. Goldin, and P. F. Hallbach, "Strontium–90 in Surface Waters," J. AWWA *52*, 756 (1960).
(5) Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, Vol. I, No. 7 (1960).
(6) Straub, C. P., "Significance of Radioactivity Data," J. *AWWA*, *53*, 704 (1961).

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Concentrations in $\mu\mu c$/liter]

Station	Quarter ending Sept. 30, 1961	September 1961					
	Strontium-90	Beta activity			Alpha activity		
		Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa	0.3	0	10	10	<1	<1	1
Animas River: Cedar Hill, N. Mex	0.3	11	13	24	4	4	8
Apalachiocola River: Chattahoochie, Fla	0.4	5	3	8	0	0	0
Arkansas River:							
Coolidge, Kans	2.3	34	41	75	0	6	6
Ponca City, Okla	[a] —	18	20	38	5	8	13
Pendleton Ferry, Ark	—	165	7	172	—	—	—
Big Sioux River: Sioux Falls, S. Dak	0.4	14	31	45	0	3	3
Chattahoochie River:							
Atlanta, Ga	—	0	2	2	0	0	0
Columbus, Ga	—	<1	2	2	0	0	0
Colorado River:							
Loma, Colo	—	188	42	230	48	2	50
Page, Ariz	—	1411	46	1457	276	11	287
Boulder City, Nev	1.0	4	28	32	0	7	7
Parker Dam, Calif	—	1	19	20	1	5	6
Yuma, Ariz	—	14	29	43	2	2	4

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

[Concentrations in μμc/liter]

Station	Quarter ending Sept. 30, 1961	September 1961					
		Beta activity			Alpha activity		
	Strontium-90	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Columbia River:							
Wenatchee, Wash	—	1	2	3	0	0	0
Pasco, Wash	1.1	46	390	436	0	0	0
Bonneville Dam, Oreg	[b] 0.6	12	143	155	0	0	0
Clatskanie, Oreg	—	10	82	92	0	0	0
McNary Dam, Oreg	1.2	16	114	130	0	<1	<1
Connecticut River: Northfield, Mass	0.4	2	6	8	0	0	0
Cumberland River: Clarksville, Tenn	0.4	6	9	15	0	1	1
Delaware River:							
Martins Creek, Pa	—	8	2	10	0	0	0
Philadelphia, Pa	—	1	3	4	—	—	—
Escambia River: Century, Fla	[b] 0.9	—	—	—	—	—	—
Great Lakes:							
Buffalo, N. Y	—	2	5	7	0	0	0
Detroit, Mich	[b] 0.6	2	14	16	0	0	0
Port Huron, Mich	0.4	4	3	7	0	0	0
Milwaukee, Wis	—	1	2	3	0	0	0
Sault St. Marie, Mich	—	<1	<1	1	0	0	0
Gary, Ind	0.2	0	0	0	0	0	0
Duluth, Minn	—	<1	5	5	0	0	0
Hudson River: Poughkeepsie, N. Y	0.2	6	4	10	—	—	—
Illinois River: Peoria, Ill	0.4	0	8	8	0	0	0
Kanawha River: Winfield Dam, W. Va	—	4	6	10	0	0	0
Klamath River: Copco, Oreg	—	2	5	7	0	0	0
Little Miami River: Cincinnati, Ohio	1.1	1	6	7	<1	1	1
Merrimack River: Lowell, Mass	[b] 0.7	0	11	11	—	—	—
Mississippi River:							
Minneapolis, Minn	0.9	2	10	12	0	1	1
Dubuque, Iowa	—	2	14	16	0	1	1
Burlington, Iowa	0.6	6	8	14	0	0	0
E. St. Louis, Ill	—	45	17	62	—	—	—
Cape Girardeau, Mo	0.8	22	6	28	3	3	6
West Memphis, Ark	—	6	9	15	2	1	3
Delta, La	[b] 0.4	10	18	28	5	2	7
New Orleans, La	—	—	—	—	—	—	—
Missouri River:							
Williston, N. Dak	—	34	13	47	—	—	—
Bismarck, N. Dak	—	4	13	17	0	5	5
Yankton, S. Dak	0.6	6	21	27	0	2	2
Omaha, Nebr	—	28	28	56	4	6	10
St. Joseph, Mo	—	75	22	97	16	5	21
Kansas City, Kans	—	61	30	91	6	0	6
St. Louis, Mo	1.4	46	18	64	21	1	22
Monongahela River: Pittsburgh, Pa	0.4	1	8	9	0	0	0
North Platte River: Henry, Nebr	—	10	32	42	1	24	25
Ohio River:							
East Liverpool, Ohio	0.4	<1	4	4	—	—	—
Huntington, W. Va	—	<1	8	8	0	0	0
Cincinnati, Ohio	—	1	9	10	0	<1	<1
Louisville, Ky	0.4	8	7	15	0	<1	<1
Cairo, Ill	1.1	—	—	—	—	—	—
Evansville, Ind	—	0	8	8	0	<1	<1
Potomac River:							
Williamsport, Md	—	3	8	11	0	0	0
Great Falls, Md	—	2	4	6	—	—	—
Platte River: Plattsmouth, Nebr	—	105	16	121	29	2	31
Rainy River: Baudette, Minn	—	14	32	46	0	0	0
Red River, North: Grand Forks, N. Dak	—	5	10	15	—	—	—
Red River, South:							
Index, Ark	—	21	6	27	2	2	4
Denison, Tex	—	8	19	27	0	0	0
Alexandria, La	1.0	6	17	23	—	—	
Rio Grande River:							
Alamosa, Colo	[b] 0.4	2	12	14	0	3	3
El Paso, Tex	—	5	5	10	—	—	—
Laredo, Tex	—	11	5	16	5	2	7
Brownsville, Tex	—	1	8	9	0	3	3
Roanoke River: John H. Kerr Reservoir and Dam, Va	—	1	2	3	<1	0	<1
Sabine River: Ruliff, Tex	—	1	4	5	0	0	0
San Juan River: Shiprock, N. Mex	—	94	18	112	18	2	20
St. Lawrence River: Massena, N. Y	—	<1	4	4	0	0	0
Schuylkill River: Philadelphia, Pa	—	5	6	11	—	—	—
Savannah River:							
Port Wentworth, Ga	0.4	10	8	18	—	—	—
North Augusta, S. C	—	2	4	6	0	0	0
Shenandoah River: Berryville, Va	—	4	10	14	<1	<1	1
Snake River: Wawawai, Wash	0.3	1	7	8	0	3	3
South Platte River: Julesburg, Colo	0.7	16	73	89	2	36	38
Susquehanna River:							
Sayre, Pa	0.3	10	2	12	—	—	—
Conowingo, Md	0.3	1	4	5	—	—	—
Tennessee River:							
Chattanooga, Tenn	0.6	1	16	17	0	1	1
Bridgeport, Ala	0.7	2	41	43	0	1	1
Truckee River: Farad, Calif	—	0	0	0	0	0	0
Yakima River: Richland, Wash	0.4	2	11	13	0	2	2
Yellowstone River: Sidney, Mont	—	420	25	445	124	3	127

[a] Dash denotes no sample received or no determinations made.

[b] April–September 1961.

Correction for February issue: The August 1961 water data, which appeared in the February 1962 issue of *RHD*, was inadvertently labeled "July 1961." July data was actually published in the January 1962 issue.

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS

Strontium-90 In Tap Water

Health and Safety Laboratory
U.S. Atomic Energy Commission

The Health and Safety Laboratory performs analyses for strontium–90 concentrations in tap water for Richmond, California, and New York City on a monthly basis. Table 1 presents the data for the second quarter of 1961 as well as the 1959 and 1960 averages. Figure 1 graphically presents this data.

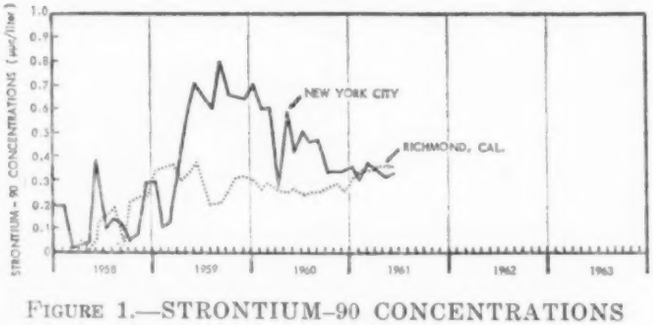

FIGURE 1.—STRONTIUM–90 CONCENTRATIONS IN TAP WATER

Previous data have been presented in earlier issues of *Radiological Health Data*. Future issues will include results of strontium–89 analyses which began with the September 1961 samples.

TABLE 1.—STRONTIUM-90 IN TAP WATER, SECOND QUARTER 1961[1]

Location	Period	Average concentration (μμc/liter)
Richmond, California (40 liters per sample)	1959	0.29
	1960	0.26
	January–June 1961	0.33
	April 1961	0.35
	May 1961	0.35
	June 1961	0.35
New York City (100–200 liter per sample)	1959	0.40
	1960	0.47
	January–June 1961	0.34
	April 1961	0.34
	May	0.32
	June	0.33

[1] Data from *Quarterly Summary Report, HASL-117*, December 30, 1961.

SECTION V.—OTHER DATA

External Gamma Activity

Radiation Surveillance Network, Public Health Service

Portable survey instruments are available at stations of the Radiation Surveillance Network for recording levels of external gamma radiation. Measurements are made daily approximately three feet above the ground. These readings are not precise, but are sufficiently accurate to illustrate any significant variations above background. The differences among the values shown in the following table are within the variance anticipated due to differences in normal background and instrument response characteristics.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, DECEMBER 1961

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Adak	Alaska	0.01	Lawrence	Mass	0.02
Anchorage	Alaska	0.01	Lansing	Mich	0.02
Attu	Alaska	0.01	Minneapolis	Minn	0.01
Cold Bay	Alaska	0.01	Jackson	Miss	0.01
Fairbanks	Alaska	0.01	Pascagoula	Miss	0.02
Juneau	Alaska	0.01	Jefferson City	Mo	0.01
Kodiak	Alaska	0.01	Helena	Mont	0.03
None	Alaska	0.01	Lincoln	Nebr	0.01
Point Barrow	Alaska	0.01	Trenton	N. J	0.02
St. Paul Island	Alaska	0.02	Santa Fe	N. Mex	0.03
Phoenix	Ariz	0.02	Albany	N. Y	0.02
Little Rock	Ark	0.01	Gastonia	N. C	0.02
Berkeley	Calif	0.02	Bismarck	N. Dak	0.01
Denver	Colo	0.02	Columbus	Ohio	0.01
Hartford	Conn	0.01	Oklahoma City	Okla	0.02
Washington	D. C	0.02	Ponca City	Okla	0.04
Jacksonville	Fla	0.01	Portland	Oreg	0.02
Miami	Fla	0.01	Harrisburg	Pa	0.01
Atlanta	Ga	0.03	Providence	R. I	0.02
Agana	Guam	0.01	Columbia	S. C	0.02
Honolulu	Hawaii	0.03	Pierre	S. Dak	0.02
Boise	Idaho	0.02	Nashville	Tenn	0.01
Springfield	Ill	0.01	Austin	Tex	0.01
Indianapolis	Ind	0.01	El Paso	Tex	0.02
Iowa City	Iowa	0.03	Salt Lake City	Utah	0.02
Topeka	Kans	0.02	Richmond	Va	0.02
Frankfort	Ky	0.01	Seattle	Wash	0.01
New Orleans	La	0.02	Madison	Wis	0.02
Augusta	Maine	0.02	Cheyenne	Wyo	0.02
Baltimore	Md	0.02			

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Direct Measurements of Fallout Gamma Dose in Sweden and New York City[1]

J. H. Harley, Health and Safety Laboratory
U.S. Atomic Energy Commission

There have been few measurements of the gamma dose rate or gamma dose resulting from weapons test fallout. In general, the levels are too low to obtain meaningful results with the usual instruments. Efforts have been made following the recent USSR test series to measure the dose rate or dose.

Some measurements made by the Radiophysical Institute in Sweden have been made available by Dr. T. Magnusson of the Swedish Institute for National Defense. These measurements are made with integrating chambers and are measured over a one-half week period. The results of these are given in table 1.

Since the middle of September, a series of measurements have also been made on the HASL roof with a portable gamma scintillation detector. These are instantaneous dose rates, however, and the subtraction of background is subject to greater statistical error. Possible increases of about 0.001 mr/hr have been noted during November 1–3, 20–22, and 27–29.

Another estimation was made by calculating the expected gamma dose rate from the measurement of total beta activity on gummed film. The gamma estimates are given in table 2. It should be noted that the gummed film estimates represent only the 24-hour fallout contribution and are not cumulative. Thus they are only indicative that the low direct gamma readings are not unexpected.

While no simple direct comparison can be made, it is apparent that the current doses from fallout in New York City are lower than those found in Sweden. This is to be expected geographically.

FIGURE 1.—GAMMA DOSE MEASUREMENT LOCATIONS IN SWEDEN

[1] Taken from *Quarterly Summary Report, HASL–117*, December 30, 1961.

TABLE 1.—GAMMA DOSE FROM FALLOUT MEASURED IN SWEDEN, 1961

[mr/hr—3½-day averages]

Location	October						November			
	9–13	13–16	16–20	20–23	23–27	27–30	30–3	3–6	6–10	10–13
Riksgransen	0.0042	0.0038	0.0023	0.0018	0.0018	0.0018	S[a]	S	S	S
Kiruna	0.0014	0.0010	0.0018	0.0013	0.0013	0.0014	S	S	S	S
Kvikkjokk	0.0006	<0.0006	0.0008	<0.0006	0.0011	0.0010	S	S	S	S
Tarnaby	0.0006	<0.0006	0.0008	0.0007	0.0010	0.0011	0.0008	0.0007	0.0008	0.0013
Ostersund	<0.0006	<0.0006	0.0008	0.0007	0.0008	0.0007	0.0010	0.0007	0.0010	0.0008
Visby	<0.0006	<0.0006	0.0017	0.0008	0.0006	0.0010	0.0011	0.0006	0.0008	0.0015
Torslanda	0.0006	<0.0006	0.0008	0.0008	0.0005	0.0006	0.0011	0.0015	0.0015	0.0015
Simlangsdalen	—	—	—	—	0.0012	0.0012	0.0012	0.0007	0.0006	0.0014
Smygehamn	—	—	—	—	0.0011	0.0010	0.0010	0.0010	0.0012	0.0011

[a] Snow cover, no measurements made.

TABLE 2.—ESTIMATE OF GAMMA DOSE RATE CALCULATED FROM GUMMED FILM AT NEW YORK CITY, 1961

[Only dose rates of 0.0001 mr/hour or greater are shown]

Date	Gamma dose rate (mr/hour)	Date	Gamma dose rate (mr/hour)
September 17	0.0003	October 21	0.0001
18	0.0001	22	0.0004
19	0.0002	November 7	0.0001
21	0.0001	13	0.0001
29	0.0006	14	0.0002
October 3	0.0001	16	0.0002
14	0.0001	17	0.0003
15	0.0002	20	0.0003
16	0.0001	24	0.0003

Strontium-90 in Miscellaneous Biological Samples[1]

Health and Safety Laboratory, U.S. Atomic Energy Commission
Soil Survey Laboratory, U.S. Department of Agriculture

In 1956, the first intensive worldwide sampling for cumulative strontium–90 levels in soils was undertaken by the Health and Safety Laboratory in cooperation with the U.S. Department of Agriculture. At some of the sampling sites, certain biological samples were available that might possibly have been of use as biological indicators of the fallout situation near the collection site. Where these samples were available, they were collected and analyzed for strontium–90 and calcium. No attempt was made to seriously seek biological indicators for a given locale but rather, different kinds of samples were obtained to see qualitatively what the effects of the fallout in the region were on the levels detected in the samples. Since 1956, sampling of miscellaneous biological materials has continued on a very limited basis.

In general, the samples analyzed were animal bones, vegetation, and soil. It was felt that soil levels would indicate the total amount of strontium–90 that had fallen in the given area, vegetation levels would reflect the cumulative deposition as well as the recent deposition of strontium–90, and that the bone levels would indirectly reflect the levels in vegetation and soil. These impressions have since been verified to some extent by the results of the pasture survey in the United States which was conducted concurrently.[1] The sporadic nature of the sampling of the miscellaneous biological materials has made it impossible to come to any firm conclusions as to any further meaning of the results or their implications as far as fallout is concerned. The results are presented in Table 1.

Two sets of samples require some explanations. They are the snowy owl pellets obtained in Barrow, Alaska, from 1956 to 1960 and the moss samples obtained at Ft. Chimo, Quebec, in 1959 and 1960. The snowy owl pellets were collected because the strontium–90 and calcium levels reflect the levels in the bones of lemmings on which the owls fed. The two different kinds of moss sampled in 1959 and 1960 were obtained in connection with soil sampling. The strontium–90 that is deposited on and in the moss may be useful in place of soil measurements in determining the cumulative deposition of strontium–90 at a given site, where perhaps this information could not readily be obtained in any other way.

[1] *Quarterly Summary Report, HASL–115,* October 1, 1961.

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TABLE 1.—STRONTIUM-90 IN MISCELLANEOUS BIOLOGICAL AND SOIL SAMPLES

Sampling locations	Sample type	Sampling period	Sr^{90} concentration	
			μμc/g Ca	mc/km²
Alaska:				
Barrow	Snowy owl pellets	1956	21	
		1957	[a] 7	
		1958	13	
		1960	53	
	Snowy owl skeletons	1960	20	
	Pomarine jaeger chick skeletons	1960	22	
	Soil	1956		1.2
		1958		1.5
		1959		4.2
		1960		3.5
Eagle	Caribou bones:			
	fawn	Oct. 1956	50	
	steer	Dec. 1956	112	
Fairbanks	Soil	1956		1.5
		1958		4.6
		1959		7.3
		1960		9.6
Mile-70	Caribou bones: Yearling	Oct. 1958	133	
Palmer	Yearling calf leg bones	Nov. 1956	4	
	Soil	1956		2.3
		1958		4.2
		1959		8.5
		1960		10.8
Canada:				
Agassiz, B. C.	Sheep leg bones	Jan. 1957	32	
	Soil	June 1957		13.5
		May 1958		18.9
		Sept. 1959		34.7
		Sept. 1960		35.1
Fort Chimo, Quebec	Caribou moss	1959	565	4.2
		Sept. 1960	940	8.1
	Sphagnum moss	1959	226	10.0
		Sept. 1960	25	7.7
	Soil (undisturbed, 0–6 inches)	June 1959		4.2
		Sept. 1960		5.4
Lacombe, Alberta	Sheep leg bones: 1 year old	1956	26	
	Soil	Aug. 1956		3.1
		May 1958		9.3
		Sept. 1959		15.0
		Aug. 1960		17.0
Reindeer Station, Northwest Territories	Reindeer leg bones:			
	9 mo. old fawn	Jan. 1959	85	
	33 mo. old steer	Jan. 1959	92	
	8 mo. old fawn	Nov. 1959	98	
	20 mo. old steer	Dec. 1959	121	
	Soil	July 1957		1.9
		July 1959		1.9
		July 1960		5.0
St. John's, Newfoundland	Sheep leg bones	1956	63	
	9 mo. old	Nov. 1958	128	
	7 mo. old	Sept. 1959	173	
	8 mo. old	Oct. 1960	114	
	Soil	Oct. 1956		3.5
		Jan. 1959		19.3
		Sept. 1959		27.8
		May 1960		29.0
Iceland:				
Reykjavik	Lamb leg bone	1960	41	
	Grass	June 1958	864	1.2
	Soil	Aug. 1958		12.7
		June 1959		24.7
		Oct. 1960		23.2
Japan:				
Fukuoka	Soil	Feb. 1958		9.6
		June 1959		18.5
		Dec. 1960		27.4
Hiroshima	Goat leg bone	1956	7	
Nagasaki	Goat leg bone	1956	4.5	
Philippines:				
Manila	Lamb leg bone:			
	5 mo. old	Apr. 1956	2	
	11 mo. old	July 1956	4.5	
	Soil	Apr. 1956		2.3
		Feb. 1958		2.7
		June 1959		5.0
		Dec. 1960		6.9

TABLE 1.—STRONTIUM-90 IN MISCELLANEOUS BIOLOGICAL AND SOIL SAMPLES—Continued

Sampling locations	Sample type	Sampling period	Sr^{90} concentration	
			μμc/g Ca	mc/km²
Puerto Rico:				
Lajas Experiment Station	Goat leg bone:			
	10 mo. old	Dec. 1957	5	
	11 mo. old	Dec. 1958	7	
	11 mo. old	Dec. 1959	9	
	10 mo. old	Dec. 1960	4	
	Soil	Sept. 1957		6.6
El Younque: (rain forest)	Soil	Sept. 1957		17.0
San Juan	Soil	Nov. 1958		12.4
		July 1959		20.1
Chile:				
Antofagasta	Cactus	Feb. 1956	1	
	Pepper tree	Feb. 1958	2.5	
	Soil	Jan. 1956		0.04
		Feb. 1958		0.15
		Dec. 1960		0.35
Punta Arenas	Sheep leg bone	Jan. 1956	7	
	Soil	Jan. 1956		0.38
		Mar. 1958		1.9
		Oct. 1959		3.1
		Dec. 1960		2.3
Australia:				
Adelaide	Sheep leg bone, 1 yr. old	May 1956	2.5	
	Soil	May 1956		1.9
		Mar. 1958		4.6
		June 1959		5.0
		Dec. 1960		5.4
New Zealand:				
Timaru	Sheep leg bone:			
	Farm A	1956	5	
	Farm B	1956	13	
	Soil	Apr. 1956		0.8
		Mar. 1958		3.1
		Sept. 1959		3.9
		Jan. 1961		4.6

[a] Old sample.

FIGURE 1.—SITES FROM WHICH BIOLOGICAL SAMPLES WERE TAKEN

Environmental Monitoring in Alaska

Project Chariot
Atomic Energy Commission

In May 1959, the United States Atomic Energy Commission approved a program of environmental studies to be conducted in conjunction with a proposed excavation project using nuclear explosives (Project Chariot, Plowshare Program) at the mouth of Ogotoruk Creek near Cape Thompson.

The proposed project, which is under study and for which the detonations have not been approved, would involve the simultaneous detonation of five nuclear devices. Four 20-kiloton devices would be buried to about 400 feet and one 200-kiloton device buried to about 800 feet. The detonation of the four smaller devices would be expected to produce a channel about 900 feet wide and 2,000 feet long, with a basin about 1800 feet in diameter resulting from explosion of the larger device. It is expected that about 95 percent of the fission products will be entrapped underground.

After the USSR resumed testing on September 1, 1961, four fallout monitoring stations were activated at Cape Thompson, Kivalina, Kotzebue and Point Hope, as shown in figure 1.

Table 1 presents the November 1961 data. The September and October 1961 data were presented in the December 1961 and February 1962 *Radiological Health Data.* No water samples were taken during November.

FIGURE 1.—SAMPLING LOCATIONS FOR PROJECT CHARIOT

TABLE 1.—GROSS BETA ACTIVITY IN ALASKAN AIR SAMPLES, NOVEMBER 1961

End of sampling period	Cape Thompson		Kivalina		Kotzebue		Point Hope	
	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)
November 1	[a] —	—	—	—	25.1	3.66	12.0	1.77
2	23.9	2.00	—	—	24.1	1.00	6.3	3.73
3	23.4	3.96	—	—	23.0	3.41	13.8	5.50
4	23.9	5.55	3.3	8.03	25.8	5.85	11.5	3.08
5	23.9	9.62	2.3	7.02	25.8	7.90	13.4	6.34
6	23.8	4.72	—	—	20.6	1.16	8.0	1.41
7	24.2	7.60	—	—	24.3	1.30	4.5	7.33
8	23.9	1.50	—	—	23.3	1.51	14.3	2.60
9	24.2	2.06	—	—	24.0	5.29	14.0	1.49
10	24.2	6.20	—	—	24.0	2.32	12.3	1.93
11	24.0	2.70	—	—	24.5	2.54	10.3	1.29
12	23.9	1.30	—	—	—	—	12.4	3.45
13	24.1	1.95	—	—	47.5	4.23	10.8	3.21
14	24.2	3.33	—	—	24.0	3.96	13.5	2.75
15	23.4	2.49	—	—	24.0	8.55	13.8	3.75
16	22.7	3.68	—	—	24.0	2.27	14.5	2.09
17	24.0	1.09	—	—	—	—	13.8	7.37
18	23.8	5.78	—	—	23.8	3.38	8.3	2.82
19	23.9	1.06	—	—	24.0	9.55	9.4	2.12
20	24.2	8.23	—	—	—	—	10.3	1.13
21	23.9	5.75	—	—	24.2	1.15	12.3	1.14
22	24.2	2.32	—	—	24.1	8.17	13.1	4.57
23	22.2	1.03	—	—	28.2	3.76	13.2	9.35
24	23.8	7.67	—	—	19.8	7.34	13.6	9.27
25	23.2	6.07	—	—	24.8	5.77	10.4	8.07
26	24.7	1.38	—	—	25.8	7.25	12.9	1.17
27	23.6	9.83	—	—	21.6	1.03	12.9	1.03
28	23.7	7.16	—	—	24.0	1.04	13.3	7.26
29			—	—	24.1	7.32		
30			—	—	24.0	8.04		

[a] Dash indicates no sample received.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission submits to the Public Health Service quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Various summaries of the environmental radioactivity data for 18 AEC installations have appeared in *Radiological Health Data* since November, 1960. Summaries follow for Knolls Atomic Power Laboratory, Lawrence Radiation Laboratory and S1C Prototype Reactor Facility, for the first and second quarters of 1961.

The measured concentration of a radioactive substance in air and water may be compared with the Maximum Permissible Concentration (MPC) of that substance as recommended by the National Committee on Radiation Protection and Measurements (NCRP). For the environment near an AEC installation, the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards Handbook 69.

For the purpose of clarity and perspective, a few of the applicable environmental MPC values are listed in table 1. Such values are intended as guides only. For further clarification, Handbook 69 should be consulted.

The establishment of MPC's does not imply that each nuclide may be present at 100% of its MPC concentration. If the concentration of each nuclide is expressed in terms of percent of its MPC, the sum of all the percent values should not exceed 100%.

In the following reports, the use of nonspecific terms as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic analyses necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's as reported by the respective laboratories.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line No.	Radioactive substance	Environmental MPC's	
		Water ($\mu\mu$c/liter)	Air ($\mu\mu$c/m^3)
1	Cerium-144	10,000	200
2	Cesium-137	20,000	500
3	Iodine-131	2,000	300
4	Plutonium-239	5,000	0.06
5	Ruthenium-106	10,000	200
6	Strontium-89	10,000	1,000
7	Strontium-90	100	10
8	Zirconium-95	60,000	1,000
9	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, At^{211}, Ra^{223}, Ra^{224}, Ra^{226}, Ac^{227}, Ra^{228}, Th^{230}, Pa^{231}, Th^{232}, and Th-nat are not present[1]	3,000	—
10	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present[1]	600	—
11	If Ra^{226}, Ra^{228} are not present[1]	100	—
12	Mixture of unidentified nuclides	10	0.04
13	If α emitters and Ac^{227} are not present[1]	—	1.0
14	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present[1]	—	10
15	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, and Bk^{249} are not present[1]	—	100

[1] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to recent FRC recommendations a group of nuclides may be considered not present if the ratio of the concentration of each nuclide to its appropriate MPC is equal to or less than 1/10 and the sum of these ratios for the group in question is equal to or less than 1/4

Knolls Atomic Power Laboratory

General Electric Company
Schenectady, New York

First and Second Quarters 1961

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959 and first quarter 1960	December 1960
Second quarter 1960	January 1961
Third and fourth quarters 1960	September 1961

The Knolls Atomic Power Laboratory (KAPL) has been operated by the General Electric Company for the Atomic Energy Commission since 1946. The principal task of KAPL is to support the Naval Reactors Program of the Commission in the development of atomic power reactors for naval propulsion. This task includes design, construction and prototype operation of nuclear power reactors.

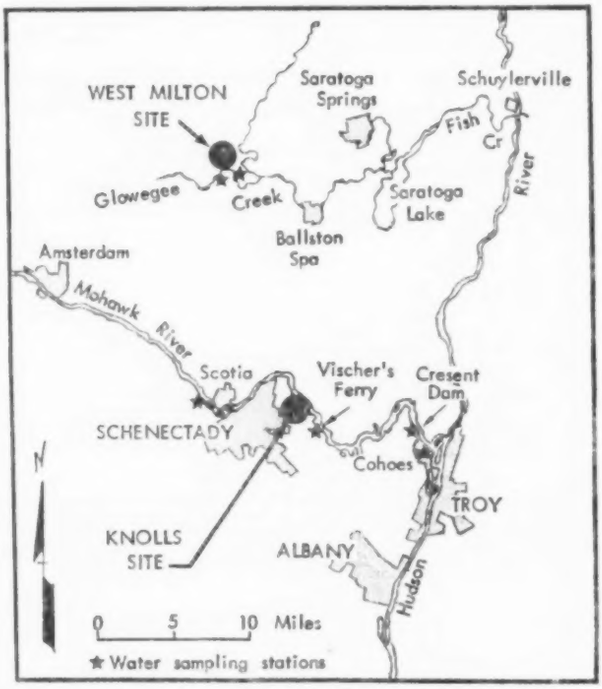

FIGURE 1.—ENVIRONMENTAL MONITORING LOCATIONS, KAPL

The Knolls Atomic Power Laboratory consists of two sites, the Knolls Site and the West Milton Site located as shown in figure 1. The former is located five miles east of Schenectady, New York, on the south bank of the Mohawk River. It occupies approximately 170 acres, upon which are located administrative buildings; chemistry, physics, metallurgical, engineering and radioactive materials laboratories; critical assembly buildings; machine shops; decontamination facilities; radioactive waste storage and processing facilities; and nuclear fuel storage and assembly buildings. The West Milton Site is located approximately 18 miles north of Schenectady, in Saratoga County. It occupies approximately 4,000 acres; principal facilities include the Triton prototype reactor, equipment service building, fuel service building and waste treatment facility. In addition, there are administration and utility service buildings. There is also a containment sphere in which the destroyer prototype reactor now is being constructed.

Air Monitoring

Environmental airborne radioactivity is measured at three locations on the Knolls Site, four locations on the West Milton Site and at the General Electric Company Research Laboratory, approximately one mile west of the Knolls Site. Airborne radioactivity is sampled continuously and analyzed on a weekly basis. The results of the airborne radioactivity analyses are given in table 2. Measurements of airborne radioactivity are made at least 48 hours after collection to allow the naturally occurring short-lived materials to decay.

TABLE 2.—AIRBORNE LONG-LIVED BETA ACTIVITY

[Average concentrations in $\mu\mu c/m^3$]

Sampling locations	First quarter 1961	Second quarter 1961
Knolls site	0.05	0.10
West Milton site	0.07	0.12
Off-site	0.02	0.09

Liquid Waste Monitoring

All potential sources of liquid radioactive waste at the Knolls Site are connected by control drains to collection tanks in the radioactive waste processing building. The release of liquid waste to the Mohawk River is regulated through the control and monitoring of the concentration of fission products in the collection tanks and the control of the discharge rate of the effluent. A continuous proportional sample of the Knolls Site combined sewer effluent is taken at the point of discharge to the Mohawk River. Radiochemical analyses of weekly composite samples show that strontium–90 is the principal component which must be considered in control. The amounts and the radioisotopic content of the combined sewer effluent discharged from the Knolls Site during the first and second quarters of 1961 have been summarized in table 3. A total of 3.814 curies of beta activity were discharged to the Mohawk River during the first and second quarters.

TABLE 3.—RADIONUCLIDE CONCENTRATIONS IN THE KNOLLS SITE WASTE EFFLUENT

[Average concentrations in μμc/liter]

Radionuclide	First quarter 1961	Second quarter 1961
Ce^{144}	6,200	6,700
Sr^{89}	1,600	1,400
Sr^{90}	4,800	6,900
Cs^{137}	5,600	5,800
Ru^{106}	<200	690
Zr^{95}	<200	<230
I^{131}	<200	460
Gross beta	20,000	23,000

Knolls Site effluent is monitored continuously for alpha radioactivity. The quarterly discharge rate was less than one percent of the environmental limit for plutonium–239.

Mohawk River water is sampled at locations upstream and downstream from the Knolls Site. The continuous sample locations are: (1) the General Electric Company Powerhouse eight miles upstream from the Knolls Site, (2) the point of discharge to the Mohawk River from the Knolls Site, and (3) the Vischer Ferry Powerhouse approximately two miles downstream. Samples taken from the City of Cohoes pumping station approximately thirteen miles downstream show about the same concentrations obtained for the Vischer Ferry samples shown in table 4.

TABLE 4.—GROSS BETA ACTIVITY IN STREAMS RECEIVING EFFLUENTS

[Average concentrations in μμc/liter]

Stream and location	First quarter 1961	Second quarter 1961
Mohawk River (Knolls site):		
G. E. Powerhouse (upstream)	4	9
Vischer Ferry (downstream)	5	7
Glowegee Creek (West Milton site):		
Upstream	6	4
Downstream	6	10

Since the Glowegee Creek does not have a reliable dilution potential, the radioactivity levels in the liquid waste from the West Milton Site are operationally controlled and diluted prior to release to the creek. A total of 0.00597 curies were discharged to Glowegee Creek during the first and second quarters at an average concentration of about 200 μμc/liter.

Samples of the Glowegee Creek water are taken once a week at two locations, 150 feet above and 2,640 feet below the point where the West Milton Site effluent enters the creek. Average concentrations found in samples of Glowegee Creek surface water for first and second quarters 1961 are shown in table 4.

Lawrence Radiation Laboratory

Berkeley, California
Fourth Quarter 1960, and First and Second Quarters 1961

In the following report data are given on environmental radiation levels associated with the operation of the Berkeley and Livermore sites of the Lawrence Radiation Laboratory (LRL). This is the initial coverage of LRL in *Radiological Health Data.*

The Berkeley site of LRL is situated on the western slope of the hills to the east of the Berkeley campus of the University of California. Winds are generally westerly; annual rainfall is 23 inches, almost all of which falls between November 1st and May 1st. Technical

facilities include a 6.3 Bev proton accelerator, a 700 Mev cyclotron, a linear accelerator of 10 Mev per nucleon, and various chemistry and physics laboratories.

The Livermore site of LRL is located on a 640 acre plot of flat ground, three miles east of the city of Livermore, California. Rainfall is approximately 12 inches per year; winds are normally westerly. Technical facilities include a small cyclotron, a 2-Megawatt swimming pool reactor, and physics and chemistry operations associated with a weapons development program.

The radiation levels given in tables 5 and 8 refer to areas accessible to the general public at the boundaries of the Berkeley and Livermore sites of the Lawrence Radiation Laboratory.

TABLE 5.—AVERAGE CONCENTRATIONS, FOURTH QUARTER 1960

Monitoring	Berkeley site		Livermore site	
	α	β-γ	α	β-γ
Air ($\mu\mu$c/m³)	0.017	2.1	0.046	0.115
Water ($\mu\mu$c/liter)	<0.2	4	<18	<116
Sewage ($\mu\mu$c/liter	<0.2	<0.6	<18	<116

TABLE 6.—AVERAGE CONCENTRATIONS AT THE BERKELEY SITE

Monitoring	First quarter 1961		Second quarter 1961	
	α	β-γ	α	β-γ
Air, stacks ($\mu\mu$c/m³)	0.007	0.43	0.152	0.5
Surface water ($\mu\mu$c/liter):				
On-site streams	0.19	4.9	0.10	8.5
Off-site streams	<0.12	<2	0.10	7.1

TABLE 7.—AVERAGE CONCENTRATIONS AT THE LIVERMORE SITES

Monitoring	First quarter 1961		Second quarter 1961	
	α	β-γ	α	β-γ
Air ($\mu\mu$c/m³):				
Radius 0.5–1.0 miles	0.043	0.25	<0.011	0.055
Radius 2–5 miles	0.038	0.29	<0.011	0.52
Water ($\mu\mu$c/liter):				
In plant well	<18	<116	<18	<116
Livermore public water	<18	<116	<18	<116
Plant effluent	<18	<116	<18	<116

TABLE 8.—EXTERNAL NEUTRON-GAMMA DOSE AT SITE PERIPHERY

[Dose in millirems]

Site	Fourth quarter 1960	First quarter 1961	Second quarter 1961
Berkeley	50	110	127
Livermore	<5	<5	<5

S1C Prototype Reactor Facility

Combustion Engineering, Inc.
Windsor, Connecticut

First and Second Quarters 1961

Previous coverage in *Radiological Health Data:*

Period	*Issue*
First quarter 1960	November 1960
Second quarter 1960	January 1961
Third and fourth quarters 1960	September 1961

The S1C Prototype is a land based nuclear submarine power plant facility. This facility is operated for the Atomic Energy Commission by the Naval Reactors Division of Combustion Engineering, Inc. at Windsor Connecticut. The Prototype contains a pressurized water reactor power plant which is used to conduct research and development work and to train personnel in operation of naval reactor power plants. Reactor power operations at the S1C prototype facility began in December 1959.

Essentially all of the radioactive wastes originate from the activation of minute amounts of impurities and corrosion products in the cir-

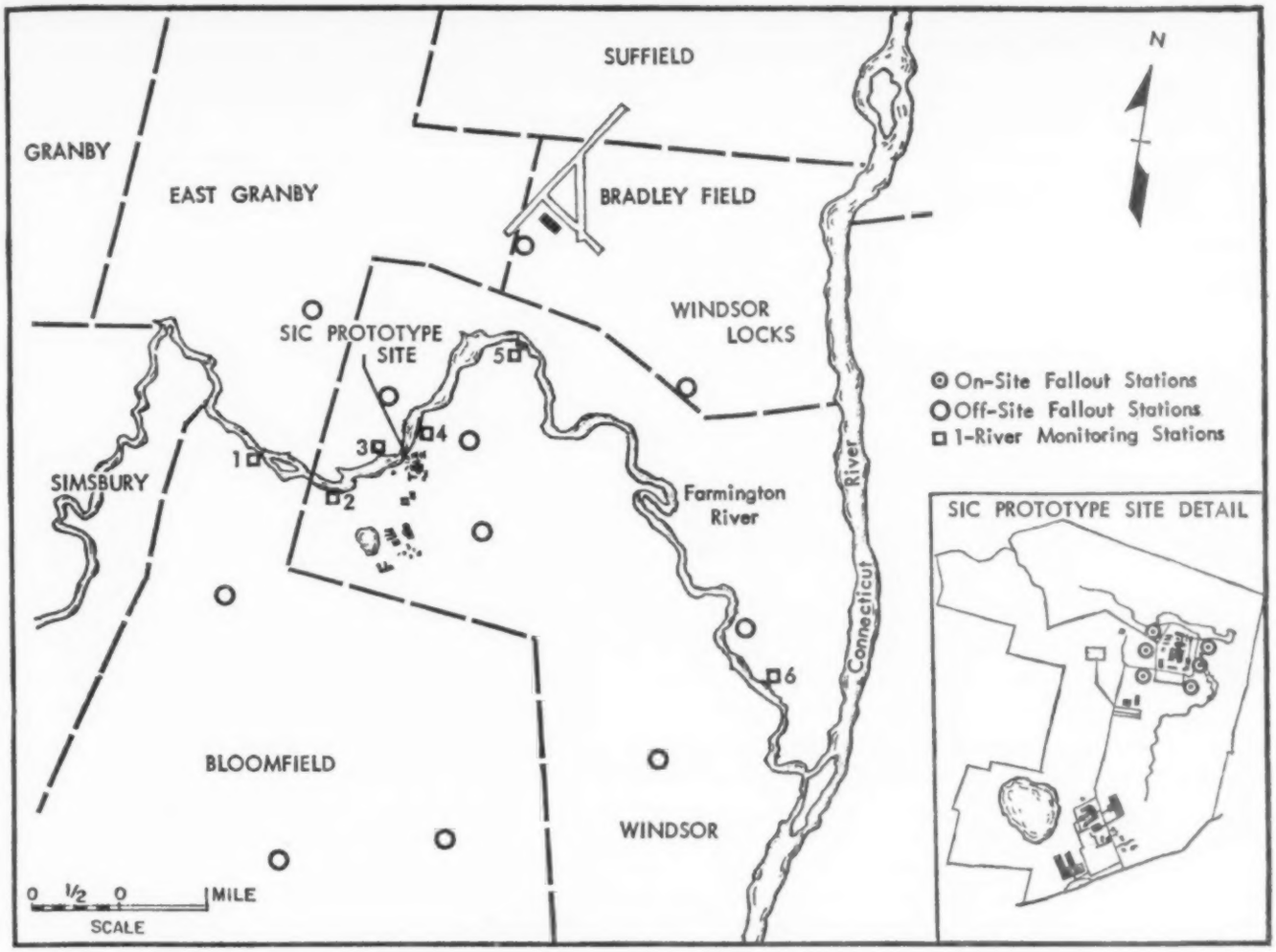

FIGURE 1.—ENVIRONMENTAL MONITORING LOCATIONS, S1C PROTOTYPE SITE

culating water used as a reactor coolant. Small quantities of gaseous waste result from the activation of minute amounts of dissolved gases in the coolant water.

Ventilation air from the submarine hull and the supporting facility is continuously monitored at the exhaust stack. Liquid wastes are monitored before discharge to the Farmington River. Tables 9 and 10 give the average beta-gamma concentrations of airborne and liquid wastes before release to the environment.

Figure 2 shows the locations of six water sampling stations along the Farmington River and 17 fallout monitoring stations. Comparing the data for upstream and downstream samples in table 11, and for on-site and off-site fallout samples in table 12, no evidence is seen of radioactivity in the environment contributed by the S1C Facility.

Refer to September 1961 issue of *Radiological Health Data* for a more detailed description of S1C Prototype Reactor Facility and its control measures.

TABLE 9.—AIRBORNE BETA-GAMMA CONCENTRATIONS

[Average concentrations in $\mu\mu c/m^3$]

Sampling location	First quarter 1961	Second quarter 1961
Stack discharge	55	46
Downward from stack	16	28

TABLE 10.—GROSS RADIOACTIVITY IN LIQUID WASTES DISCHARGED INTO THE FARMINGTON RIVER

Type of measurement	First quarter 1961	Second quarter 1961
Total for quarter	0.74 mc	2.80 mc
Average concentration	550 $\mu\mu c$/liter	1300 $\mu\mu c$/liter

TABLE 11.—BETA-GAMMA CONCENTRATIONS IN THE FARMINGTON RIVER

[Average concentrations in $\mu\mu c$/liter]

Sampling location (see figure 2)		First quarter 1961		Second quarter 1961	
		Number of samples	β-γ	Number of samples	β-γ
Upstream:	1	1	9.5	3	4.3
	2	1	8.7	3	8.2
Outlet:	3	1	9.1	3	2.2
Downstream:	4	1	<1.0	3	4.0
	5	1	2.7	3	1.5
	6	1	5.5	3	5.5

TABLE 12.—BETA ACTIVITY IN FALLOUT

[Average deposition rate in mc/km² per month]

Sampling locations	First quarter 1961		Second quarter 1961	
	Number of samples	Deposition rate	Number of samples	Deposition rate
On-site (6 stns)	17	0.234	62	0.425
Off-site (11 stns)	37	0.556	43	0.410

Reported Nuclear Detonation

Radiological Health Data, Volume II, Numbers 10, 11, and 12, and Volume III, Numbers 1 and 2, published dates of the Union of Soviet Socialist Republics and the United States announced nuclear detonations through January 31, 1962. The following table gives information on the subsequent tests reported through February 28, 1962. Low yield range has been announced as meaning about a nominal (20 kiloton yield); low-intermediate to mean between a nominal and one megaton yield.

Test number	Location	Date	Size	Type of test
		REPORTED U.S.S.R. DETONATIONS		
32	Semipalatinsk	February 2, 1962	Detectable—unknown	Underground
		REPORTED U.S. DETONATIONS		
13	Nevada Test Site	February 8, 1962	Low yield	Underground
14	Nevada Test Site	February 9, 1962	Low yield	Underground
15	Nevada Test Site	February 15, 1962	Low yield	Underground
16	Nevada Test Site	February 19, 1962	Low yield	Underground
17	Nevada Test Site	February 19, 1962	Low yield	Underground
18	Nevada Test Site	February 23, 1962	Low yield	Underground
19	Nevada Test Site	February 24, 1962	Low yield	Underground

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